Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LIX. AUGUST, 1920. No. 2.

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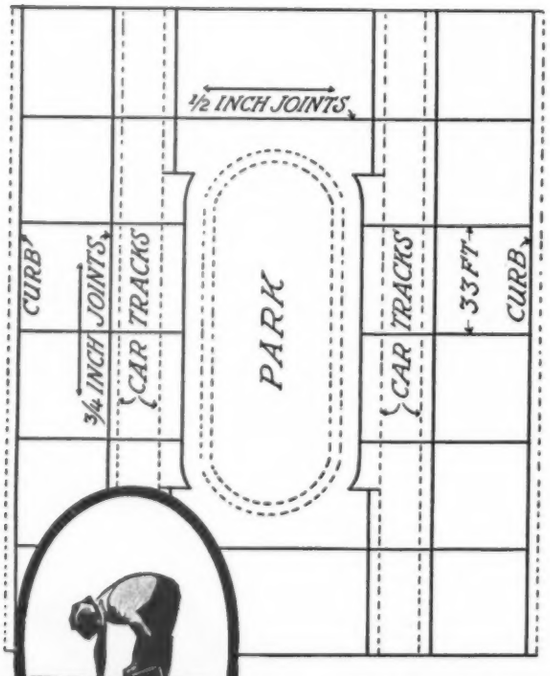
Carey Elastite

NAME REG. U.S. Patent Office

EXPANSION JOINT —protects at every point



When Elastite was first introduced some engineers feared to install it transversely in the pavement, fearing it would wear down faster than the paving.

But Elastite is different, very different, from poured joint and from every joint that does not have felt walls and sandwich construction.

Years of experience have proved absolutely that ELASTITE does NOT wear down faster than the paving or cause the paving to spawl at the joints.

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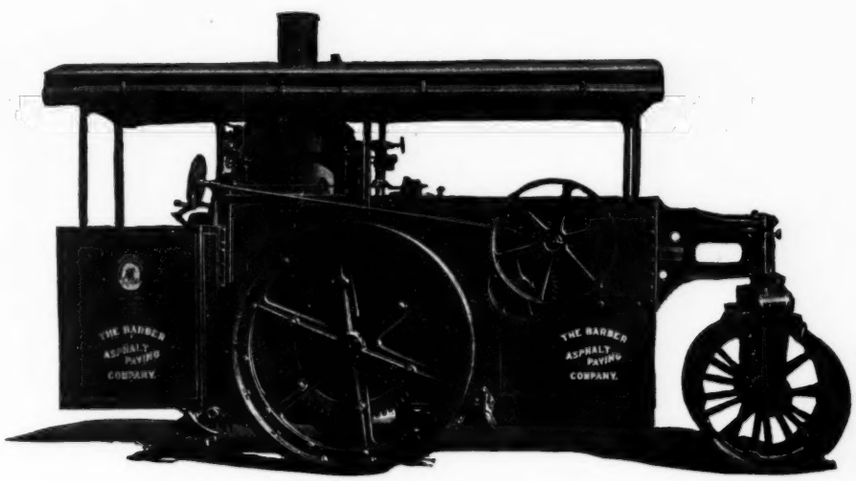

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The New Iroquois Macadam Roller was built to end macadam roller troubles. It is the product of 40 years' experience in the design and construction of road machinery.

The new Iroquois not only is more powerful and less expensive to operate than the old-type roller, but its revolutionary changes in design insure longer life, fewer repairs and greater service value.

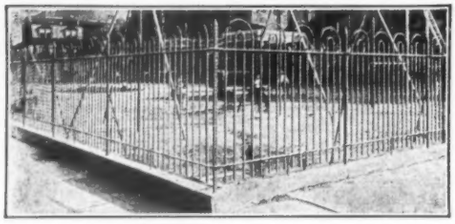
Every working part of the New Iroquois Macadam Roller is a *separate unit* resting on a steel frame, and supporting no weight but its own. This eliminates rack and strain and makes repairs easy and inexpensive.

The new Iroquois has many other exclusive points of excellence, each one a reason why you should buy an Iroquois in preference to any other macadam roller. Ask the man who runs one or write for full and detailed specifications to

The Barber Asphalt Paving Company

Iroquois Sales Department

Philadelphia



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It sticks to concrete like molasses sticks to the fingers. It acts like liquid rubber, and will last longer.

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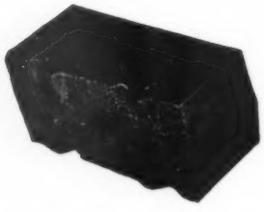
LAWRENCEVILLE, ILL.

Springfield Wire-Cut Lug



IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.
SPRINGFIELD, ILLINOIS

Truscon Curb Bars

Protection for Concrete Curbs— Corners of Walls, Columns, etc.

Truscon Curb Bars provide a substantial protection and reinforcement for concrete curbs, also for exposed corners of walls, pilasters, columns, platforms, sidewalks, etc. Manufactured from open hearth steel, heavily galvanized after forming. Positive anchorage—no separating or splitting of concrete at corners. Owing to their rigidity and cnnvenient size, Truscon Curb Bars are easy to handle and install. Furnished either straight or curved; 1⅝-in. protecting edge.

Truscon Edge Protectors provide a 1-in. protection edge, ample for many conditions, such as corners of platforms, walls, etc.

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Warehouses and Sales Offices in Principal Cities

Reinforcing Steel, Metal Lath, Steel Windows, Steel Buildings, Pressed Steel, Cement Tile, etc.

TEXACO

ASPHALT FILLER

TEXACO Asphalt Filler being applied by the pouring can method.

TEXACO Asphalt Filler being applied by the squeegee method.

ELASTIC

Expansion in hot weather and contraction in cold weather are the natural enemies of brick or block pavements.

TEXACO Asphalt Filler acts as an elastic joint between the brick or blocks, and therefore allows the pavement to expand and contract.

ADHESIVE

TEXACO Asphalt Filler has a superior quality of adhesiveness which results in its sticking firmly to the brick or block at all temperatures.

TEXACO Asphalt Filler on brick or block pavement after six years' main-street wear.

How to Apply TEXACO Asphalt Filler

TEXACO Asphalt Filler is applied usually by one of these three methods:

1—By pouring the material into the spaces between the brick from pouring cans which have trough-shaped spouts.

2—The "squeegee method" in which the hot asphalt is poured directly over the surface of the brick and then forced into the joints by either rubber or hot iron squeegees.

Two applications are usually desirable, and the asphalt should be applied at a temperature of from 350 to 400 degrees Fahrenheit.

After the asphalt has been applied, in both these methods a uniform spreading of clean, sharp sand, heated to about the same temperature as the asphalt, should be made. Lastly, a roller should be run over the pavement.

3—The Mastic filler method, in which case the asphalt and sand are heated separately and mixed together while hot, using an equal amount of each. Then the mixture is spread with squeegees over the pavement, filling the joints flush with the pavement.

PROTECTIVE

The function of protection is one of the most important performed by TEXACO Asphalt Filler, as it prevents the edges of the brick from being chipped. In addition it reduces the noise of traffic to a minimum, and furnishes an impervious, waterproof joint.

[Specifications furnished on request]

The Texas Company

ASPHALT SALES DEPARTMENT

17 Battery Place New York City

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BITOSLAG

Reg. U. S. Pat. Office

AN improved asphaltic concrete pavement composed of finely ground slag and especially prepared asphalt.

Bitoslag has demonstrated in practice that is is designed to meet all the demands of modern traffic.

Write for descriptive matter.

Bitoslag Paving Co.

90 West St., New York, N. Y.

Concrete Roads must be reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's

Concrete Reinforcement

Fulfills every engineering requirement.

Send for our book on road building

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The ELGIN LINE OF Motor Driven Street Cleaning Machinery

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with REILLY'S IMPROVED PERMANENT CREOSOTE OIL

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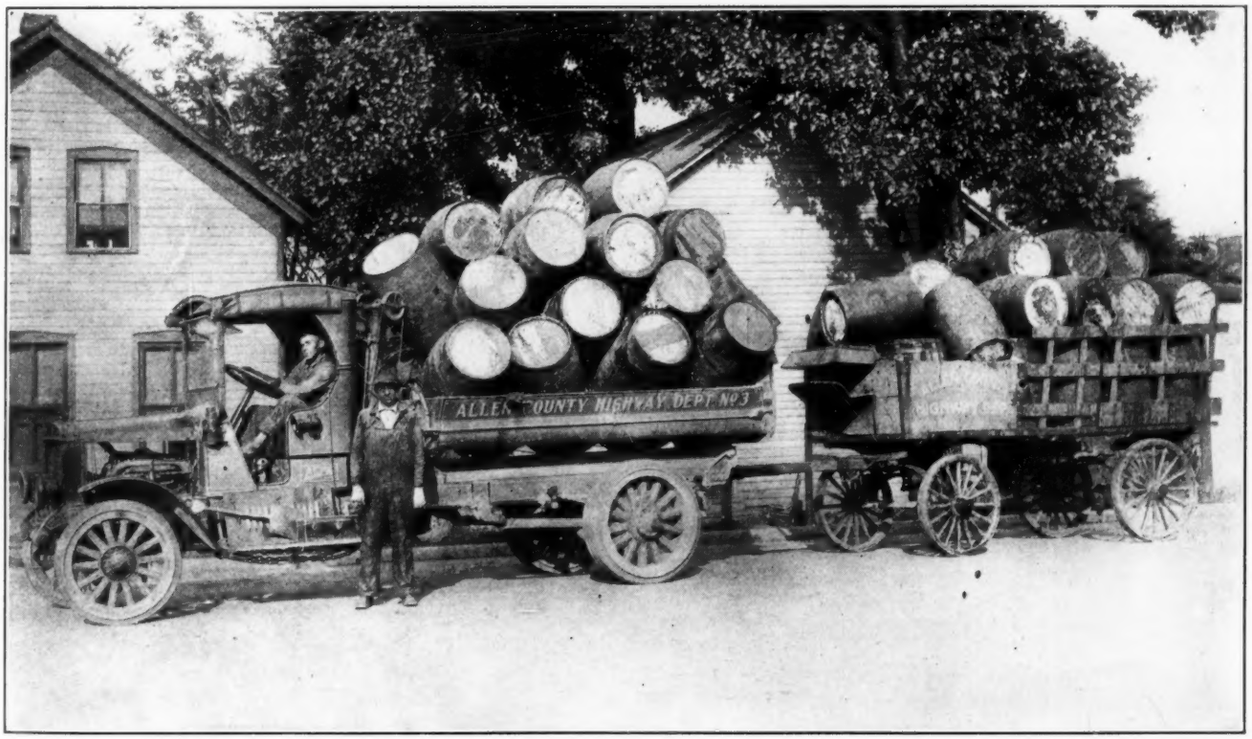
MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



ACME 3½-TON TRUCK WITH TRAILER, LOADED WITH BARRELS OF "TARVIA," AS OPERATED BY THE COUNTY COMMISSIONERS OF ALLEN COUNTY, INDIANA.

Printed as insert to Municipal and County Engineering, Chicago, Ill., August, 1920.

Motor Truck Operation and Accounting LX

Mr. R. W. Stewart, Chief Deputy City Engineer of Los Angeles, Calif., says that a cost comparison of motor and horse haulage must take into consideration the distance hauled, character of road, and facilities for quick loading of trucks. In general his city uses truck haulage for distances of two miles or over where there is a good road to run on.

Importance of Good Truck Service by Local Dealers

Buyers of motor trucks are learning that it pays to consider the facilities of local agents to render service in selecting one make of truck in preference to another. Thus Mr. Wm. B. Fowler, City Engineer, Memphis, Tenn., writes us as follows:

"I think that the usefulness of a motor truck can be summed up in the expression that it is only as efficient as the service rendered by the local agent. Our experience has been that 90 per cent. of the time our trucks are tied up, it has been by our inability to secure the necessary repair parts from the local agent. In fact, the local agent as a rule carries very few repair parts for the various sizes of trucks.

"There is no question in my mind as to the economy of motor truck transportation, if the local agent is able to give the necessary service. We would not be willing to condemn any particular make of truck on account of the failure on the part of the local agent to render service, but at the same time this is one of the big features in the success of motor transportation and should be one of the leading factors in determining the type or make of truck that you should purchase."

Acme Street Flushers Give Satisfaction at Cleveland

Three Acme 3½-ton trucks with 1000 gal. flushing units have been in use in Cleveland for over a year, operating day and night with no service expense to the city of Cleveland whatsoever. They have displaced 12 teams and 24 men. The Board of Public Works has found them so satisfactory that an order was placed a few weeks ago for two more 3½-ton Acmes equipped the same as the first three units. This is the type that is also in operation at Eveleth, Minn., and Tyler, Texas, where they are displacing the "white wings."

Regulating Weight and Speed of Truck Traffic on Pennsylvania Highways

Within the last few weeks a number of arrests of motor truck drivers have been made at the instance of inspectors for the Automobile Division of the State Highway Department of Pennsylvania, and many men have been fined for carrying overloads on their machines.

Several weeks ago inspectors for the Department and State Policemen began an inspection of the trucks coming into Pennsylvania. These officials were equipped with lodometers, or "jack scales." With these machines it is possible to get the approximate weight of trucks. The lodometer is a mechanism with a jack attachment and is placed under the axles of trucks suspected of being over weight. Two lodometers are placed first under the rear axle, which is then jacked up. The dials on the lodometers give the weight carried on the rear end of the truck. Then the lodometers are moved to the front axle and that end is raised. The total weight registered front and back gives the approximate weight of truck and load. Under the State law trucks must have painted on the outside, the maximum weight limit permitted by the manufacturer of the car. If the lodometers show that this weight limit has been exceeded the inspectors take the truck to the nearest scales where an exact weight is secured.

Under the law no commercial vehicle may carry a

SERVICE 3½-TON TRUCK AS OPERATED BY FREEDLUND CONSTRUCTION CO., MIAMI, FLA.

DUPLEX TRUCKS

BUILT FOR BUSINESS

Patented Spring Suspension prevents damage to Radiator

Motor Meter set in Radiator shell prevents loss by theft

Two Wonderful Runs That Show the Remarkable Stamina and Power of the Duplex Limited

Duplex Limited carrying 3060 pound load from Los Angeles to El Centro via San Diego, 267 miles in 8 hours 26 minutes. Los Angeles to San Diego, 132 miles in 3 hours 49 minutes. San Diego to El Centro, 135 miles in 4 hours 37 minutes. Average speed 34 miles per hour. Entire distance without stop. No relief driver. Rain from Santa Ana to Oceanside. Speed limit observed in all towns in transit.

DUPLEX BUILT FOR BUSINESS

Duplex Limited carrying 3750 pounds of potatoes from New Orleans to Baton Rouge, 124.6 miles in 6 hours 55 minutes running time. Elapsed time 10 hours 10 minutes with 3 hours 15 minutes lost by ferry delays. The motor never missed and the water in radiator boiled only once and that after a 12 mile pull through "gumbo." After a 46 mile run in 2 hours to Port Allen the motor meter registered "warm."

HERE in this Duplex Limited is the definite practical achievement of the motor truck industry's aim to produce a truck that could freight 1½ to 2 tons at high speed.

This Duplex Limited is no mere city delivery wagon—but a strong rugged *road truck* capable of hauling 3000 to 5000 pounds over city or country roads, and doing it on *schedule* time.

Designed and built for pneumatic tires—not merely equipped with them—the Limited travels easily and smoothly enough for even very fragile freight. Minimum vibration and shock saves wear and tear—and adds longer life to the truck.

Its motor is wonderfully rugged and powerful—and when turning over only about 1300 r. p. m. it drives the truck along at 25 miles an hour on high. Gear ratio is 5½ to 1 insuring high speed at minimum wear on motor and other moving parts.

Electrically equipped throughout — which means economy of gasoline as drivers will shut off motor when truck is not running.

The Radiator is suspended in patented Duplex Spring Suspension—which allows ¼ inch sidewise and 1 inch up and down movement before radiator touches anything solid. Prevents damage to radiator solderings and eliminates the great source of radiator leakage.

Lamps equipped with Nitrogen bulbs are mounted on radiator to prevent bulb damage by vibration.

Motor meter made part of radiator shell to prevent loss by theft.

Ball bearings used throughout—engineering tests show it requires 29 times less power to move a given load when ball bearings are used. *This means a gasoline saving due to less friction.*

Special flapper valve in oil filler pipe keeps sand and grit out of oil reservoir.

From every angle of mechanical value and economical operation this Duplex Limited is a real truck—the very kind you've been looking for in your business.

Have the Duplex dealer demonstrate the Limited. It *makes good*—and will *cut your trucking costs and give reliable service.* Write for complete details.

If you have heavy hauling to do—write for booklets about the Duplex 4-Wheel Drive—America's Leading Heavy Duty Truck. "DUPLEX DOINGS"—The Truck Owner's Magazine sent free to all truck users.

Address Dept. 13-A

Duplex Limited lifted clear of ground by wire around windshield frame. Strength of cowl means safety and less vibration.

Duplex Truck Company

Lansing • Michigan

One of the Oldest and Most Successful Truck Companies in America

weight greater than that specified by the manufacturer. It is on this point that arrests are now being made throughout the State. The Automobile Division inspectors find that the greatest loads are being carried after dark; and they report steady streams of huge motor vehicles constantly plying between New York and New Jersey points and Philadelphia. The fine for over-loading trucks is from $25 to $100 and in addition costs are levied, or a six months' jail sentence may be imposed. The fine goes into the treasury of the municipality in which the arrest is made.

The Department's lodometers in future will be in continuous use throughout the State and trucks will be stopped and weighed on the highways.

"Users of the roads of Pennsylvania must not lose their sense of proportion," said State Highway Commissioner Sadler. "There is a legal limit for truck weights beyond which owners or drivers of trucks must not go. Our new highways are being built to carry certain weights specified by the legislature. We will not permit road users to violate those regulations. Arrests will continue to be made so long as these violations continue."

Commercial vehicles are divided into seven classes. The maximum weights allowed for these classes, including chassis, body and load, are as follows:

Class AA, 7,000 lbs.; class A, 11,000 lbs.; class B, 15,000 lbs.; class C, 20,000 lbs.; class D, 24,000 lbs.; class C, and F, 20,000 lbs.

No commercial vehicles may travel at a rate of speed in excess of that shown in the following table:

Class AA, 20 miles per hour; class A, 20 miles; class B, 18 miles; class C, 15 miles; class D, 15 miles; class E, 12 miles; class F, 10 miles.

The Department calls attention to the requirement of the law that commercial vehicles must have painted on a conspicuous place on the outside and on both sides in figures 3 ins. high the maximum weight limit of the vehicle, this weight limit to include chassis, body and load.

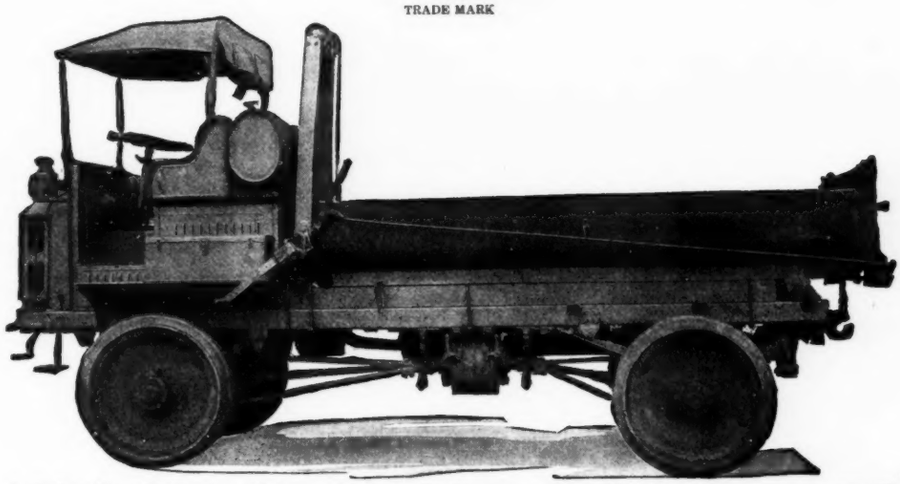
U. S. TRUCK AS OPERATED ON ROAD WORK BY S. K. JONES, FRIAR'S POINT, MISS. THE U. S. SPREADING DEVICE SAVES LABOR OF FOUR MEN IN SPREADING GRAVEL ON THE ROAD.

Duplex Truck Factory Uses Trucks to Provide Power for Factory Machinery During Coal Shortage.

During the recent coal shortage the Duplex Truck Company again demonstrated ability to surmount serious difficulties. Without a steam power plant and with no electric power due to the coal shortage, the Duplex Company was able to operate all departments with every

DRIVER OF KISSEL TRUCK EVENLY SPREADING A LOAD OF ROAD MAKING MATERIAL WITHOUT LEAVING HIS SEAT.

TRADE MARK



A Columbian Lightning Hoist and Dump Body mounted on one of the Government FWD trucks. The Indiana State Highway Commission has 65 trucks with this equipment.

Performance Counts In Road Building!

That is why the

Columbian Lightning Hand Hoist

PATENTED

is so often specified when purchasing road equipment. Its record of successful performance in the past assures you of its ability to serve you satisfactorily and economically in the future. No matter what kind of a truck you are using, the COLUMBIAN LIGHTNING HOIST in connection with a Columbian Steel Dump Body will increase the efficiency of your road building equipment by it's speed, capacity, and ease of operation.

The COLUMBIAN LIGHTNING HOIST is based on mechanical principles so simple that there is practically no chance for it to get out of order, yet so sound that one man can easily dump a 5-ton load. While it has been built with the idea of quality rather than price, yet the first cost is so reasonable that this, together with the absence of maintenance costs, makes the Columbian Hoist a most satisfactory purchase from the standpoint of economy.

Write us today for our illustrated circular No. 96 and learn how Columbian Dumping Equipment can serve you.

COLUMBIAN STEEL TANK CO.

"TANKS FOR THE WORLD" "ESTABLISHED IN 1894"

1519-1625 WEST 12th STREET KANSAS CITY, MISSOURI.

man on the job. Power for the plant was found in eight Duplex 4-Wheel Drive trucks and two birds were killed with one stone because in driving the machinery the trucks were tested out and gas conserved.

Realizing that the coal situation meant a complete shut down for the plant which was facing an unprecedented demand for the new "Limited" trucks, far beyond any anticipation, a serious problem was confronted.

A plan was worked out whereby eight trucks were placed to turn line shafts and two trucks to do the work of the 50 h. p. electric motors run in normal times to operate the plant.

The truck motors were driven at maximum speed under governor control. The operation of the plant was less expensive with the trucks than with the electric power.

Truck motors were given a two-day test-out and then a new motor was hooked up with the shafts. The plan worked perfectly and every employee was kept on the job.

Using Trucks for Short Haul Freight

"By employing the motor truck for short hauls the railroads could then utilize space now going to waste that would equal the capacity of thousands of new freight cars," says Harry Branstetter, Chicago Kissel distributor.

"If manufacturers realized this situation and employed their own motor trucks for short hauls instead of sending the goods down to the freight depot for the railroad to transport them, they would undoubtedly receive more shipments of raw materials and supplies that come from longer distances, because the railroads would have the added equipment that is now tied up in short haul work.

"For instance, I understand 54 per cent. of our freight cars are running empty most of the time, while 37 per cent. are running less than carload shipments, while only 10 per cent. are carrying a capacity load and working full railroad time."

Motor Trucks and Bad Roads

"How much of a factor are good roads in economical truck operation?" asks Mr. H. M. Lee of the Duplex Truck Co. Mr. Lee points out that while good roads enhance the economies to be derived from trucks, it should be recognized by all that trucks will operate economically over roads as they are today as well as over the kind of roads everybody would like to see in existence everywhere. His interesting statement on this subject follows:

"First, of course, it should be stated that good roads are tremendously important and that the better the roads the better the performance will be, other things being equal.

"But in the effort to get good roads, it is not true that somewhat of an impression has been created that the present day trucks are not fit to operate where roads are bad or where there are no roads at all, and that, consequently, a man in that position had better stick to horses and mules?

"After reading all the articles one has seen lately that are evidently inspired propaganda with a view of hastening the development of good roads, one is left rather with the impression that trucks are not safe and that the development of the motor truck had best be held up till roads are made good all over the country.

" 'Heaven knows we need good roads'—but business men all over America need trucks today whether the roads are good or bad.

"They need them especially in an effort to save time and they need them also to offset—insofar as may be—the increasing price of everything else that enters into transportation.

"The point to my mind is this—that a truck, particularly a heavy duty truck or a medium capacity truck—both of which are designed for service and intended to be used—should be so made and designed as to be able to negotiate even so-called bad roads and do it more economically than teams can do it.

KISSEL TRUCK ENTERING A GRAVEL PIT FOR A LOAD.

KISSEL Truck performance *plus* for contractors, excavators, engineers, road builders, etc., is due to the Kissel-built motor, designed, perfected and manufactured by Kissel for truck purposes only.

A correspondingly high degree of dependability is built into the brakes—the heavy, flexible springs of specially selected steel—the pressed steel frame, sturdy to withstand overloads.

It is this practice of making each unit a little stronger and more wear-resisting than necessary that keeps Kissel Trucks on the job day in and day out—year in and year out.

Four models give a size for every contracting equipment. Our truck advisory service, insuring the right sized model for every contractor is at your service.

Get in touch with the nearest Kissel distributor transportation engineer—located in all principal cities.

Kissel Motor Car Co., Hartford, Wis., U. S. A.

Originators of the ALL-YEAR Truck Cab

KISSEL TRUCKS

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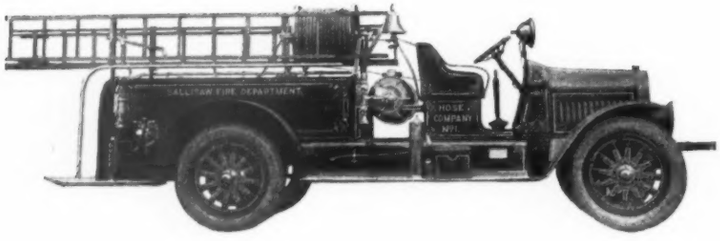

ACME FIRE TRUCK ON 1-TON ACME CHASSIS AS OPERATED BY SALLISAW, OKLA. FIRE DEPARTMENT.

"If they cannot do this—then are they, after all is said and done, practical trucks for a man to buy?

"A railroad locomotive is designed to run on rails—a truck to run on roads, and in justice to the buyers, should they not be designed to run on roads as they are instead of being designed or sold to run on roads as they ought to be?

"The whole thing is that buyers if they read these good road articles are bound to get the impression that the truck as yet is not mechanically safe and that they had better wait until it is made safe for use under practical conditions.

"Now men in the industry know, of course, that there are many trucks being made today that are entirely capable of operating economically and satisfactorily over roads as they are—but does the truck-buying public know that and are they as confident of it as the motor truck builders themselves?

"We know, of course, that any truck will operate better on a good road than it will on a poor road—but the big point is that a good truck, if bought right—by that I mean if the truck used is one that is built for the kind of work that it has to do—will show an economy over horses and mules or any other form of transportation under the same conditions.

"That is the big contribution of the truck to the business men of America—it provides cheaper transportation on roads as they are today, carrying the kind of merchandise which we have to move today with the kind of men we must employ to drive them.

"We have hundreds of letters, for example, in our office and doubtless other makers have the same, which show that trucks are operating not only where roads are bad but where there are no roads at all.

"Take trucks, for example, which operate in the logging industry; which are used for road making; which operate in the oil fields; in use by telephone companies in stringing lines over new territory—and the hundred and one purposes for which trucks are used where roads are not good—these show the every day economy and value of the truck.

"The whole thing sums itself up perhaps in the fact that many trucks are not bought right. It may be taken for granted that all trucks are mechanically as well built as the makers know how to build them and that most of them are honestly built.

"Those which are dishonestly built and which show themselves to be mechanically wrong will eliminate themselves—but today it can surely be taken for granted that the great number of trucks built by American builders are good and built well and that they will show an economy if the buyer will use them for the kind of work for which they are built and in the way in which any good truck deserves to be used."

Saving the Roads

"How are we going to save the roads?" asks R. E. Fulton, Vice President of the International Motor Co., recognizing that this is a problem requiring the attention of all. His statement continues:

"Highway transportation as a public and commercial necessity long ago received its certificate of economic justification. It has entered into the nation's scheme of things with the same wholeheartedness that characterized the railroads in their periods of development. It has

ONE OF A FLEET OF FOUR TITAN TRUCKS DISCHARGING 3,000 BRICK.

Packard Truck with special dump body for county road development. Such municipal departments as Fire, Street Cleaning, Ash and Garbage Removal, Water Works, Post Office, etc., are getting the advantage of Packard low transportation costs in many cities.

Is the City Official Getting the Full Benefit of Continued Maintenance

FROM his own practical experience in many public departments and works, the City or County official knows the benefits of continued expert maintenance.

That is why he asks, before he buys a truck today, "*What sort of maintenance organization will you put behind my truck?*"

In more than 200 Packard Service Stations you find Uniform Service Methods, Uniform Stock-keeping Methods—a uniform system in place of the haphazard, time-consuming practice found in the average repair shop.

You find more than one hundred repair operations standardized—workmanship improved, time saved, costs reduced.

Cooperation between owner and Packard Service is carried out by a system of monthly truck inspections whereby more efficient operation and low maintenance are assured.

The Packard Technical Service Division was established to give the fullest advantage of Packard's 44 factors of engineering superiority, and the long life built into every Packard Truck.

And the official, with ever the reduction of city expenses in mind, is quick to realize the effect this Packard expert maintenance will have in cutting down city transportation costs.

"Ask the Man Who Owns One"

PACKARD MOTOR CAR COMPANY, *Detroit*

found its place and is exercising a powerful influence toward shortening the gap between producer and consumer. It has reached the point, in fact, where its extension must necessarily be restricted for the good of its own future and the future of the nation's transportation as a whole.

"Legislators, highway engineers, and those intimately concerned with motor vehicle expansion realize that unless some measures restricting the use of motor trucks are enacted, this country's progress toward its ultimate state of highway perfection will be long drawn-out and tedious. Even after we have constructed a system of hard-surfaced national highways it will be necessary to provide revenues for their upkeep and maintenance. To this end, it is but equitable that those vehicles which cause the greatest amount of damage to the roads should be restricted in their use at the present time, and that in the future they should contribute the largest share toward road repair costs.

"At this time, when legislation to accomplish this must necessarily assume definite form, to influence motor transportation for all time to come, it is vitally important that we make a far-reaching unbiased analysis to determine just where the basis of this restriction belongs. Not only must we save the roads, but we must do so if possible without sacrificing the increasing economies and conveniences that unquestionably would go with an expansion of motor transportation facilities.

"There is a special field of transportation in which the motor truck is the only logical means of conveyance. How large a field it is, is shown by the fact that 300,000,000 tons of material were shipped by truck in 1919. Suppose this freight were transported in 1-ton trucks. It would mean that 900,000,000 tons of traffic (including weight of vehicles and cargo) would pass over the roads of this country. If transported in 7½-ton trucks the roads would have to bear only 600,000,000 tons of traffic. This is because the average 1-ton truck carries 2-tons of vehicle weight for every ton of freight transported while in a 7½-ton truck this ratio is reduced to less than one ton of vehicle weight for each ton of freight capacity. Regardless of what form restrictive legislation may take, the total amount of material shipped in motor trucks in 1920 will obviously be greater than the total for 1919. This country is suffering from various kinds of shortages but they are almost all directly the result of inadequate transportation. Since no other transportation agency can now take the place of the motor truck in its own recognized sphere, it is obvious that every heavy duty truck barred from the roads will be replaced by several smaller trucks. The result will be increased road wear and increased cost of transportation. As practically all products of the farm and factory make some part of their journey from producer to consumer in motor trucks, it is necessary to make sure there is no other alternative before framing legislation which will increase motor transportation costs.

"There are many fields of short distance light delivery, in which the lighter truck is better adapted. However, when bulk hauling is considered, the light truck's greatest asset in comparison with its big brother is its speed. For a 2-ton truck to transport material as economically as a heavy duty model it would be necessary for it to travel at three times the speed of the larger truck. Of course the light truck cannot do this but it does travel at a considerably higher normal speed. Its increased speed, however, produces road wear in excess of that caused by the heavy truck in spite of the fact that the latter is accomplishing far more. It has been definitely proven that increased speed causes more rapid road wear than increased weight. It is not necessary that the heavy duty truck resort to destructive road speeds in order to furnish economical transportation.

"Tire width bears an equally important relation to comparative road wear. A steam roller for example is about the heaviest vehicle which passes over a highway, yet because of its broad road bearing surface its effect on the roadway is beneficial rather than harmful. Likewise weight in a motor truck is destructive only when not accompanied by a sufficient width of tire. The fact is well-established that a load of 800 lbs. per inch of tire surface is not damaging to an ordinary roadway and the heavy duty truck is always built to conform to this requirement. A 7½-ton truck has 1 in. of tire width for each 666 lbs. of weight.

Transportation Committee of Federal Highway Council

There is to be no let-up in the nation-wide movement to bring the highway into its logical position as an efficient factor in transportation.

This has been determined by the Federal Highway

ONE OF TWO TITAN TRUCKS DELIVERING 120 BAGS OF CEMENT ON CONCRETE ROAD JOB FOR W. H. PIPKORN CO.

MEAD-MORRISON SERVICE

LIFTS THE LOAD OF INDUSTRY

Mead-Morrison material-handling equipment, backed up by Mead-Morrison Service, is doing valuable work and saving time and money in varied lines of the nation's industry.

Mead-Morrison Engineers have, in each unit of the Mead-Morrison line, built a material-handling machine whose power, dependability, economy and length of life has been proven by performance.

No problem is too intricate for this efficient combination of utility and service. Mead-Morrison engineers see to it that the purchaser not only gets the proper equipment, but that each piece is utilized to assure maximum usefulness.

MEAD-MORRISON Truck Winch

shown here is a practical illustration of the Vertical Capstan Winch in operation. One man, with the aid of the Winch, is enabled to move this heavy piece of machinery weighing sixteen thousand pounds. Without the Mead-Morrison Winch its handling, with any number of men, would be a difficult problem.

—TRUCK WINCH DISTRIBUTORS—

Auto Truck Equipment Co.,	Pittsburgh, Pa.	Kunkel Wagon Co ,	Baltimore, Md.
Edward R. Bacon,	San Francisco, Cal.	Mansfield Steel Corp.,	Detroit, Mich.
Horizontal Hoist Co.,	Chicago, Ill.	Motor Truck Equipment Co ,	Philadelphia, Pa.
Hummel Mfg. Co.,	St. Louis, Mo.	William Ogden,	Indianapolis, Ind.
Interboro Hoist & Body Co.,	Brooklyn, N. Y.	Springfield Commercial Body Co.,	Springfield, Mass

The Truck Engineering Co., Cleveland, Ohio.

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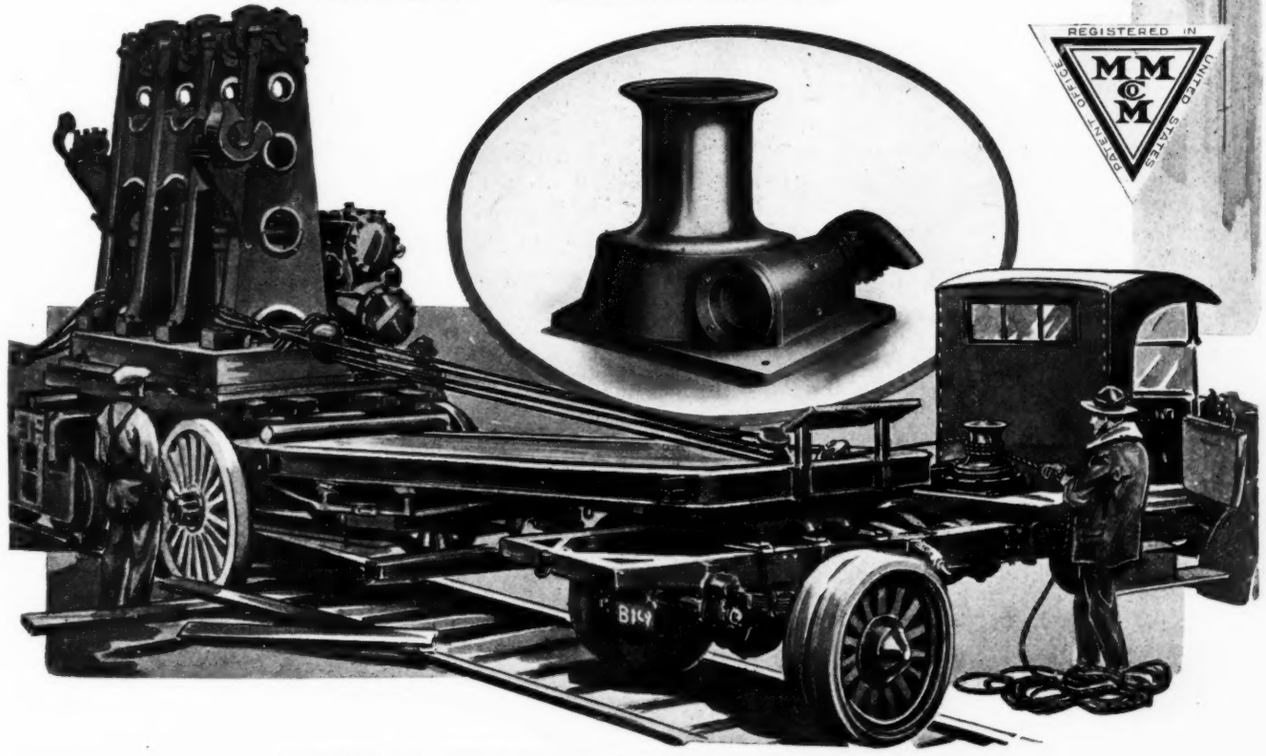


Council in cooperation with Chambers of Commerce, Commercial Clubs, civic bodies and other affiliated organizations. Committees are being appointed to direct the work in its more important branches.

The Transportation Committee of the Council already includes men with wide experience in transportation problems. Cooperating with the Committee are Dr. R. S. McElwee, Director of the Bureau of Foreign and Domestic Commerce, Lieutenant Colonel J. M. Ritchie of the War Department, and Mr. Lee L. Robinson of the United States Council of National Defense.

Mr. W. J. L. Banham, General Traffic Manager of the Otis Elevator Company, New York City, and a member of the Executive Committee of the National Industrial Traffic League, is in charge of a committee on policy toward other forms of transportation. His committee will make a close study of short haul and terminal problems. This study will include transportation problems in new territory, transportation surveys, the motor truck in terminal work, store door delivery, motor truck statistics—including costs, rates, etc., and the use of trailers in reducing cost per ton mile.

Mr. J. H. Collins, Manager of Research Bureau-Chilton Company of Philadelphia, and formerly of the Bureau of Markets, United States Department of Agriculture, is Chairman of the Committee on Rural Motor Express. The scope of the work of this committee embraces a study of franchises, insurance, uniform receipts and bills of lading, marketing, return loads, and the present status and development of machinery for putting the rural motor express into actual operation.

The study of highway transport functions of State Highway Departments, including snow removal, traffic surveys and traffic control by State Highway Departments, to the end that constructive suggestions for assistance may be offered where desirable, will be in charge of Mr. David Beecroft, Directing Editor of The Class Journal Company, New York City.

The development of a policy of cooperation with motor truck users' organizations will be in charge of Mr. W. H. Stone, Associate Editor of the Manufacturers' Record, Baltimore.

Cooperation in educational work with universities and schools will be directed by Professor A. H. Blanchard, professor of highway engineering, University of Michigan, and president of the National Highway Traffic Association.

The general policy of the Transportation Committee of the Federal Highway Council, is under the direct charge of Mr. Charles W. Reid, formerly Executive Officer of the United States Council of National Defense. It may be stated as follows:

"To assist in coordinating highway transportation with the other transportation agencies of the country; to encourage the development of highways that will advance the economic life of the nation; stimulate their use in such a manner as to facilitate and cheapen the transportation of food, raw materials and finished products, and cooperate with Government agencies, both state and national, to the end that our highways may be of maximum service in the transportation system of the country."

The purpose is "to recognize the problems of the road builder, to realize the needs of the road user, to visualize

ACME

"—as much work again as any truck I hire"

"With my two-ton Acme, I can do just as much work again as any truck I hire. I do not think, from my experience with other trucks, that there is any to compare with the Acme in capacity."

The owner of the truck pictured above writes this together with some very interesting data on the competitive performance of his Acme and other trucks he hires occasionally. The outstanding performance of Acme trucks in contracting and engineering service is a matter of actual record. The principle of "proved units—Acme constructed" proves its merit under the strenuous conditions of this work.

Contractors and engineers are invited to correspond with us on the subject of truck operation as applied to their work. We have made a special investigation of Acme performance in this field and are prepared to supply some very interesting information.

Built in 1, 1½, 2, 3½ and 5 ton Models

Acme Motor Truck Co.
316 Mitchell St. Cadillac, Mich

ACME THE TRUCK OF PROVED UNITS

Seal of Dependable Performance

Trade Mark Registered in U. S. and foreign countries

THE SCOOP CONVEYOR

OVER 2000 USERS

FOR STORING AND RECLAIMING, LOADING AND UNLOADING CARS, TRUCKS AND WAGONS

DOES THE WORK OF FROM 6 TO 12 MEN AND KEEPS EQUIPMENT MOVING

WRITE FOR LITERATURE

PORTABLE MACHINERY CO., PASSAIC N.J.

GRAMM PIONEER BERNSTEIN

All Gramm-Bernstein worm drive models carry, as standard equipment, accessories which are essential to the satisfactory operation of any truck, and which are worth $550 to $600 at today's prices.

The Gramm-Bernstein Motor Truck Co.

LIMA, OHIO, U. S. A.

Builder of the First Liberty (U.S.A.) Truck

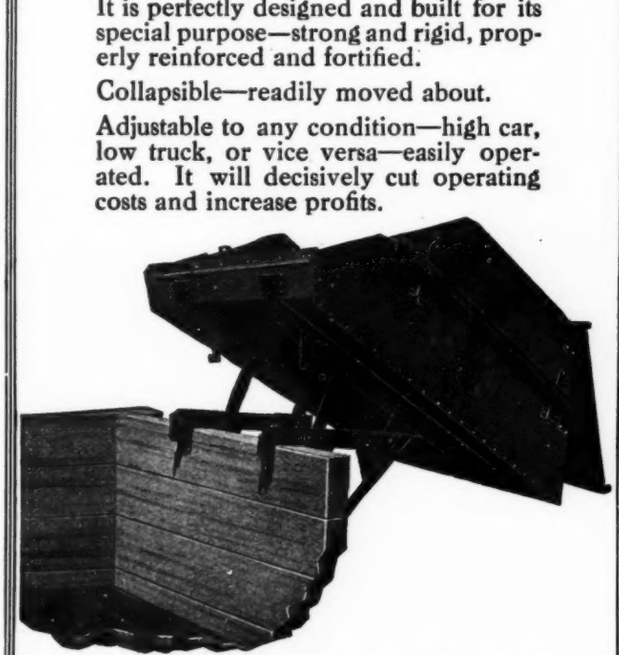
THIS IS THE

Heltzel "Lightning" Loader Skip

It is perfectly designed and built for its special purpose—strong and rigid, properly reinforced and fortified.

Collapsible—readily moved about.

Adjustable to any condition—high car, low truck, or vice versa—easily operated. It will decisively cut operating costs and increase profits.



The Heltzel Steel Form & Iron Co.

WARREN, OHIO.

GARFORD

The Solution of the Transportation Problem

In the present crippled condition of the transportation facilities of the country, the motor truck is proving itself vitally essential to the relief of present economic conditions and to the proper and satisfactory handling of the Nation's business.

The support of motor trucks and good roads by statesmen and financiers the country over will help—

Keep the Traffic Moving

Garford

Lima, Ohio

TRUCKS

future highway transportation requirements, to cooperate with the railroads, waterways, and other agencies of transportation to the end that the public may enjoy that form of transportation which is most efficient, economical and practical."

The Council has just received notification from Mr.

DIAMOND T TRUCK AS OPERATED IN CONJUNCTION WITH STEAM SHOVEL ON CONSTRUCTION WORK.

George W. Taylor, President of the American Railway Express Company, that their Vice President and Treasurer, Mr. F. S. Holbrook would represent the Express Company on its transportation committee. When completed the Committee will include representation from all agencies of transportation.

The Motor Truck's Part in the Terminal Congestion Problem

"Freight congestion is, in reality, terminal congestion," says R. E. Fulton, Vice President of the International Motor Co. "The present railroad situation vividly demonstrates that the root of the much discussed railroad inadequacy lies more in the lack of proper terminal facilities than it does in the lack of freight cars. It has further proved that the motor truck, properly used in conjunction with railroad terminals, can relieve terminal congestion and increase the productivity of each unit of the railroads' rolling stock.

"Although it is estimated that the railroads of this country now need 500,000 more freight cars, it is obvious that, if this number of cars were put into service under existing terminal conditions, the confusion would only be increased.

"Unfortunately, the majority of railroad terminals were constructed in the days of horse-drawn highway transportation facilities, and no provision was made for the advent of the motor truck. At that time it was necessary for the railroads to bring their freight within a radius of a day's team haul of its final destination, a distance considerably less than can now be covered by a motor truck. Cities have grown and traffic has increased, but the terminals have remained practically unchanged as far as distribution radius is concerned. As a result, the railroads are still attempting to operate on a horse-drawn basis of ultimate distribution and, consequently, freight piles up in the yards and the tracks are filled with trains awaiting their turn to be unloaded. Although motor trucks are now being used to a large extent instead of horses, the platform area available for transferring shipments from the freight car to the truck is so confined that it is impossible to avoid congestion.

"It is a fact that the average freight car travels only about six miles a day, and that this inefficiency can be attributed directly to wasted time through terminal congestion. Considering that we now have over 2,400,000 freight cars in use, it can be seen that every mile per day added to the productivity of this total by increasing terminal efficiency, is the equivalent of 400,000 more cars. Thus it is obvious that if a continuous movement of freight cars to and from their terminal points can be obtained, a two-fold advantage will result; first, eliminating the delay and waste incidental to congestions, and second, releasing a vast number of cars for main line traffic.

"To say that this can be accomplished by utilizing the motor truck is not a mere prophecy—it is a proven reality. The few railroads that have applied the use of trucks in their limited way to this problem have met with remarkable success and should stand as uncompromising examples to every railroad now affected by terminal congestion. For example, figures compiled by the U. S. Railroad Administration show that in the Big Four yards at Cincinnati, the use of motor trucks with demountable bodies has reduced the time required per ton-mile for transfer shipments from 12 hours and 18 minutes, to less than 3 minutes. This saving of time is accomplished by a reduction of 50 cts. per ton mile on the cost of the transfer shipments. The New Jersey Central Railroad has adopted motor truck service in connection with its Jersey City terminal in a way that indicates immense possibilities for minimizing congestion. This terminal became so congested during the recent general tieup that it become useless to send loaded freight cars there. So Plainfield, N. J., a city nearby was made a terminal point and goods are now being transferred there to motor trucks and hauled into Jersey City and other destination points.

"This idea of diverting shipments, while not a new one, has up to the present been confined to emergency use. It seems logical, however, that the diverting principle presents the most practicable means for permanently relieving the railroads of terminal congestion. By establishing sub-terminals at the outskirts of large cities on the various lines of approach, freight loads could be transferred to motor trucks and delivered to the consignees far more rapidly and economically than at present. This method would also relieve street traffic in the congested parts of large cities because: (1) the terminals would then be adapted to use the more rapid and flexible moving motor truck instead of horse-drawn equipment, (2) the number of vehicles bringing and receiving goods at terminals would be divided in their operations to different parts of the city, and (3) the large capacity trucks could be utilized for handling carload lots, thus minimizing the number of vehicles required to handle transfers.

"The motor truck is now a permanent supplement to the railroads and has proved its capacity to take over the short haul traffic that has developed to be time-wasting and unprofitable business for them. By 'feeding' short haul shipments to the main line traffic, it has released thousands of cars for long distance transportation and has done much toward relieving congestion at terminals. But the development of this cooperative relation between the railroad and the motor truck is still in its infant stages.

EVERY ISSUE FOR 5 YEARS!

This is Motor Truck Section No. 60!

That means, of course, that every issue for five years the publishers of Municipal and County Engineering have segregated in this section practically all matter in the issue pertaining to the use of motor trucks in municipal and county service and in highway transportation.

That this steadfast attention to the motor truck has exerted a tremendous influence on the sale and use of trucks in this field no fair-minded informed person will question.

The truck has demonstrated its worth and it is here to stay. Scores of letters received monthly from truck users in all parts of the country attest the economy of the truck. We are constantly seeking facts and figures for publication in this department, on the performance of trucks in this field. The co-operation of everybody is requested.

Since 1890 this has been a very strong road and street magazine. During the past five years we have pointed the way to co-operation between motor and highway interests and this co-operation is producing a great system of improved roads and streets for all the uses of the public.

Municipal and County Engineering
538 S. Clark St., Chicago, Ill.

HALL TRUCKS

HOW IN THE SOLUTION OF OUR OWN TRUCKING PROBLEMS HALL TRUCKS HAVE GIVEN BETTER TRANSPORTATION TO ALL THE WORLD

THE reason HALL Trucks so admirably meet the transportation problems of modern business is a simple one.

As makers, handlers and transporters of heavy structural steel for more than forty-six years, this company had its own trucking problems.

None of the many trucks we had tried proved equal to the difficulties we had to meet. None lasted sufficiently long in our unceasing, heavy work.

So we decided to build our own trucks—transports capable of withstanding severe punishment over a period of many years.

And thus was born the HALL Truck five years ago.

As steel analysts and manufacturers, Hall engineers knew the capabilities of truck strength and endurance. As truck users in the most difficult of truck usage, they knew the users' need.

HALL Trucks, therefore, are designed and manufactured by men whose forty-six years' experience in the study of heavy transportation problems has peculiarly fitted them for the task of producing the world's most durable truck.

HALL Trucks have solved our own hauling difficulties. They have more than met the expectations of other users.

Business men find HALL Trucks lastingly dependable. HALL Trucks are serving hundreds of business men with marked ability and freedom of repairs.

It will pay you to look into the Hall line and see why it is the foundation of so many high-grade hauling systems.

Address Sales Manager, 23 Roby Street

LEWIS-HALL MOTORS CORPORATION

Manufacturer of the HALL Trucks.

As Manufactured by
The LEWIS-HALL IRON WORKS
DETROIT, MICHIGAN.

EDITORIALS

ENGINEER AND PROMOTER

In these columns last month two prominent engineers were quoted in their endorsement of a promoter's candidacy for the United States Senate. They referred to him as a promoter of the type to which engineers are deeply indebted. They said: "It is such men who have made possible the practice, promotion and development of the profession to which we belong." The editor expressed the opinion that this view of the promoter comes much closer to the exact truth than statements frequently made by engineers on this subject.

The engineer will lose nothing to which he has just claim in acknowledging his debt to the promoter of an enterprise ultimately requiring the exercise of engineering talent. But engineers stand to lose much of the regard of other men when they set the promoter at naught and claim all the credit for themselves in the consummation of a work which adds to the public wealth and happiness. At times the engineer has, perhaps, rather thoughtlessly regarded himself as the chief builder of a railroad, to take an illustration familiar to all but outside the field of this magazine, failing to recognize that he has been but one of the various classes of men who have cooperated in the achievement. This narrow view is not well calculated to increase the popularity of the engineer or to enhance the regard in which he is held by men of affairs.

Of course there are promoters and promoters. The Wallingford type is known in fact as well as in fiction. Opportunities to abuse the functions of the promoter exist but the seizure of such opportunities should not reflect discredit on honest endeavor. Legitimate promotion we must have in order to accomplish anything worth while calling for engineering services. It is with a proper regard by the engineer for these legitimate functions that we are concerned in this discussion.

Just as there are different types of promoters so, also, are there different types of promotion. Sometimes promotion is an end in itself and sometimes it is a means to an end. An example of the latter class of promotion, familiar to all, is that done in connection with the sale of equipment or the materials of construction. In this case the seller engages in the promotion of projects on the construction of which his equipment or construction materials may later be utilized. This is a very important class of promotional work which exerts a strong influence on the engineer, both with respect to the performance of his services and in the creation of his opportunities to serve. Stated more plainly, the promotional activities of equipment and material men not only must be reckoned with at times in the performance of the engineer's work, but the engineering job itself may, and frequently does, depend directly on the success or failure of these promotional activities of the so-called "supply men." Isn't it well to recognize these facts?

Frequently it has seemed to us that engineers are disposed to take a rather ungenerous view of the salesman's efforts to create a demand for his goods. There is such an over-supply of indolence and lethargy in the world that without vigorous efforts few things can be sold in worth-while volume. The entire construction industry is indebted to the honest promotional and sales efforts of the material men. No matter how legitimate the project it must be sold to the public and the selling is frequently done by commercial interests as one step in the sale of equipment and supplies. So long as these activities are honestly and fairly conducted no one should take exception to them, last of all the engineer who finally is called upon to perform his function on a project which has been sold to the public with or without his assistance.

We are moved to make these frank observations in the interest of straight thinking and in giving credit where it is due. We object to narrowness as the greatest obstacle to the normal development of the profession. Let us not be too harsh in our criticisms of the manufacturer's salesman; his job is a hard one and he needs cooperation as well as criticism.

As an example of the sort of short-sighted criticism to which we have made reference the case may well be cited of a state highway engineer who said: Many persons, especially those interested in the manufacture and sale of motor vehicles have become dissatisfied with the results secured under the Federal Aid Highway Act." We confess we can see nothing in this statement but a gratuitous "slam" at the agency which has done more than any other for good roads in this country. That motor interests have been, are, and will continue interested in fostering the good roads movement everybody knows. There has been no secrecy on this point. Of course, motor interests are anxious to promote the construction of good roads, and why not? There are obstacles in plenty, never fear, and there is no danger of over-promotion that we can detect. It is indeed fortunate for the country that there has been built up a vigorous young industry which possesses the requisite energy, money and brains to work successfully for a national system of dependable highways. We surmise that the labors of this group are largely responsible for the fact that we have 48 state highway departments and 48 state highway engineers. Even in those states which had highway departments before motor interests and motorists took up the good roads crusade, much favorable sentiment has been built up, directly and indirectly, to support those departments as a result of the educational work carried on by "those interested in the manufacture and sale of motor vehicles," aided and abetted by those

interested in the use of such vehicles. We have added a reference to the user of motor vehicles as he is on friendly terms with the "automobile people" and is often seen in their company. In fact, it is suspected that he buys and operates motor vehicles only because he finds it advantageous or quite agreeable to do so. We do not see any possibility for public service, therefore, in an insinuation made by a public servant against an agency which is serving the public so well that it profits from doing so. Perhaps it is well to add that these remarks are intended to be good natured and constructive. The state highway engineer quoted happens to be one who commands our admiration and respect and it is because of this that we regret his rather ungenerous reference to an agency which has extended much indirect assistance to all honest, sincere workers in the highway field.

That promotional work, whether carried on as a means to an end or as an end in itself, is neither always honest nor wise we are perfectly well aware. However deplorable this fact may be, let us remember that such activities are quite as likely to be inspired by high motives as any other. Where a real service is rendered let us not hesitate to acclaim it, whatever be the garb or the vehicle of the servant.

Many who appreciate the attainment and capacities of the engineer are looking to him to do more and more of the promotional work himself. Engineers, therefore, who are dissatisfied with the promotional work which comes under their observation, have a perfect right to assert themselves and do their own promoting.

In a recent editorial The Lexington, (Ky.) Leader, in the course of a discussion of the non-capitalistic captain of industry (the engineer) said: "It is now a large practice for engineers of ability to seek out independently opportunities for the investment of capital or for the utilization of natural resources. Herbert Hoover is one of the successful examples of this latter class who are sure to grow in numbers and influence every year. The engineer is becoming so important, as a matter of fact, that the day may not be long distant when he will take first place in industry and progress, the place occupied for centuries by the capitalist."

We trust engineers will give thought to these matters and that they will view with a generous eye the works of which they are among the chief beneficiaries. Where they feel that they can improve upon the promotional work being done by others, they are at complete liberty to make the attempt, assured of a rich reward if they succeed.

PRIDE IN A DAY'S WORK

In early life it was our privilege to sit at the feet of men who took deep pride in doing a big day's work. They gloried in their strength and welcomed the opportunity presented each day for their maximum production. Such were the makers of America. Men of that breed conquered the wilderness and the great barren spaces and made them productive and useful. America is still sound at heart because of our nearness to these men. Our literature abounds in tributes to them. Longfellow's Village Blacksmith appeals strongly to all for it recognizes the nobility of labor and renders homage to a true man.

Organized labor has derived its strength largely from public sentiment based on the older conceptions of labor and an honest day's work. The overwhelming majority of Americans have engaged in hard manual labor, day after day, over a long period of years, or are but a generation removed from it. Most of us have looked with sympathetic eyes on the efforts of laboring men to improve their living and working conditions, remembering old times and the old, old injustices to the toiler. But always we have expected that labor would continue to be worthy of its hire.

Latterly a serious question has arisen as to whether or not labor can stand its prosperity, so recently acquired and so long sought. Pride in the day's production has been superseded by hot demands for higher and still higher wages in exchange for lower and still lower production. Many feel that labor has abused its newfound strength. The laborer with his incessant strikes and his cold, calculating time-killing is rapidly losing the sympathy of the great middle class, the white-collared group that stands between labor and capital and would preserve justice and order in industry just as the old marines stood between the forecastle and the quarterdeck to put down mutinies arising in one end of the boat and to protect the ordinary seaman against the heartless autocrat who held forth in the other.

Unless organized labor abandons its false idea of limiting production to increase prosperity it will suffer an irreparable loss. Already it has alienated the sympathies of a multitude of its former well-wishers. The entire labor movement is doomed to early and complete disaster unless laboring men again work hard. They must produce, thus earning more, or forfeit all claim to public sympathy in their efforts to get higher or even their present wages.

We believe that practically all our people believe in a square deal. They want to see the laboring classes properly compensated and adequately protected against ruthless exploitation. But the public will sternly insist that labor do its part. Labor must return to the old way of working or lose its present high wages. The individual laborer is quite capable of differentiating between what is right and what is wrong. He must do what he knows that by every standard of right he should do: he must work hard.

DESIGN OF THE MIAMI, FLORIDA, CAUSEWAY ACROSS BISCAYNE BAY

By B. H. Klyce, of Klyce & Kackley, Civil and Consulting Engineers, 721 Fourth and First National Bank Bldg., Nashville, Tenn.

The Miami Causeway is being completed across Biscayne Bay on the southeast coast of Florida to connect the City of Miami with the City of Miami Beach.

Both Miami and Miami Beach are well known winter resorts, and Miami is of some commercial importance, which will be much enhanced in the next few years as the Everglades are drained and opened for settlement.

Miami Beach is located on a peninsula but heretofore the only means of communication with the main land has been a wooden bridge nearly three miles long spanning the bay and connecting the two cities; this bridge was wholly inadequate and was decaying rapidly; it became necessary to replace it with something more permanent.

Biscayne Bay is a shallow body of water having an average depth of water at this point of about 5 ft. except along the eastern side where there is a dredged channel 2,000 ft. wide with a depth of water of about 15 ft. Five to 15 ft. of sand and mud overlie the soft rock bottom peculiar to this region. This rock is quite porous, has many "pot-holes" in it and is so soft that it may often be excavated with an hydraulic dredge without the use of explosives; in general, however, it is found cheaper to use explosives; large boulders however are rarely dislodged, most of the debris being capable of being handled by a 20 in. hydraulic dredge.

Elements of the Causeway

The normal range of tide in the bay is about 18 ins., and since there are no streams of any importance emptying into the bay above the causeway, permission was secured from the War Department to make a solid fill 13,000 ft. long flanked at either end by an opening 2,000 it, long to be spanned with concrete viaducts; in each one of these viaducts is placed a bascule bridge with 60 ft. clear opening.

The embankment is located along the north side of the ship channel which crosses the bay; it is parallel to this channel and has its south wall about 82 ft. distant from the north side of it. The excavated material from the ship channel had been deposited along the north side of it largely by hydraulic dredge and is in a very compact condition; it is composed of a mixture of sand and rock with some mud; it is on this spoil bank that the embankment for the causeway is constructed.

In designing the embankment portion it was considered important that such a structure would be built that it could resist the tropical hurricanes which occasionally sweep this region. It is not anticipated there can be much damage from direct wave action since the bay is quite shallow.

Three Types of Construction Considered

Three types of construction were considered: (1) An embankment with sloping sides protected by riprap, (2) an embankment with sloping sides protected by marl, and (3) an embankment with vertical sides. The first design had to be rejected since the only stone locally available for riprap is soft, light, friable and furthermore cannot readily be secured in large masses. The second design with the slopes protected by pure marine marl laid on flat slopes of about 6 to 1, such as used quite successfully by the F. E. C. Ry. on some of their well known over-the-sea railroad construction, was not feasible on account of expense, there being no known beds of pure marine marl locally available. In considering the third type it was not possible to consider anything other than cresoted lumber for the walls on account of the limited appropriation.

The embankment as designed is 105 ft. wide and is composed of two parallel walls of cresoted wooden sheet piling and waling tied together with wrought iron tie rods and filled with sand and rock. The piling are driven nearly to rock. The ends of the tie rods where exposed to the weather are protected by a coat of hot pitch. The entire surface is now being paved with the native broken stone to a thickness of 12 ins. applied in two courses. This stone has a peculiarly high cementing power and makes a pavement practically impervious to water.

A street car line has been built and a 40 ft. oiled macadam highway is being constructed now with provision made for a steam railroad and a concrete sidewalk to be constructed in the future.

The Viaducts

The viaducts are of reinforced concrete construction and are composed of a series of spans each 30 ft. center to center of piers. Expansion joints are placed 120 ft. apart. The viaducts provide for a roadway 20 ft. wide, a sidewalk 5 ft. wide on one side, and one electric railway track on the opposite side outside of the roadway. The portion occupied by the electric railway track consists of open track construction carried on steel L-beams of 30 ft. span. The roadway is paved with Kentucky rock asphalt, the sidewalk is of concrete and there is a concrete handrail on the sidewalk side only. The load-

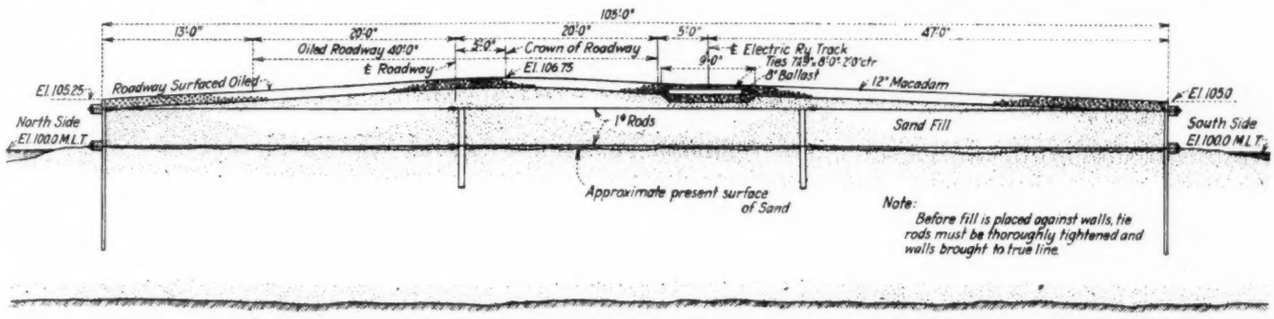


FIG. 1. TYPICAL CROSS SECTION OF EMBANKMENT, SHOWING TIMBER BULKHEAD CONSTRUCTION, THE MIAMI CAUSEWAY, ACROSS BISCAYNE BAY, MIAMI, FLORIDA.

ing provided for is two 40-ton cars with impact on each electric railway track, while on any part of the roadway a 9-ton motor truck with impact or a uniform load of 100 lbs. per sq. ft. without impact is used.

Construction Features

The principal point of interest in the construction of this part of the work is the method used for the construction of the pier shafts. Soundings were taken where each shaft was to be placed and its exact length to the underside of the cross girder determined; then the shafts were all cast at a yard conveniently located where the work could be most carefully inspected for the placing of the reinforcement and of the concrete; it should be noted that the vertical rods for connecting of pier shafts to cross girders and also to basis were left projecting;

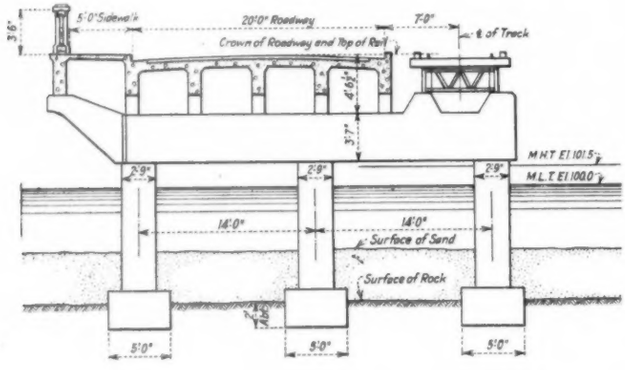


FIG. 2. CROSS SECTION OF THE MIAMI (FLA.) CAUSEWAY.

they were then allowed to cure at least three weeks before being moved. They were then picked up by a derrick barge which utilized the projecting reinforcing rods to lift them by and loaded them on barges, which were then towed to the site of the work.

In the meantime the excavation for the pier bases had been completed and the caissons driven. The derrick barge now lifted one of the pier shafts and suspended it in its proper caisson and exactly in position leaving it a little high; wooden blocking was now placed across the caisson resting on the steel sheet piling; to each of the reinforcing rods in the four corners of the pier shafts had previously been attached a threaded rod with hexagon nut, by means of which the load of the pier shaft was taken from the derrick and transferred to the blocking; also it was now possible by lowering on one or more corners to secure exact verticality of the pier shaft. Then the concrete for the pier bases was deposited by tremie, care being taken to see that the concrete was brought high enough to insure that the laitance which averaged about 6 ins. thick would all be above the bottom of the pier shaft. It will also be noted that the bottom of each pier shaft was shaped as a blunt wedge to prevent likelihood of air being pocketed underneath in the placing of the concrete for the base. One complete pier shaft and base which had been damaged were lifted out of the water and the base cut away to determine whether solid contact over the whole area of the base of the pier shaft was being secured; this was found to be the case.

By this method of construction it was possible to secure a "dry-land" viaduct. It should also be noted that since these piers were reinforced and to be subjected to the action of salt water the utmost care was taken to secure a very dense and impervious concrete by importing a very superior grade of sand and by general care in the mixing and placing of the concrete.

The bascule bridges are of the Scherzer Rolling Lift Bridge type.

Contracts were let in the latter part of 1916 for the construction of all this work except the bascule bridges to the Bowers Southern Dredging Company of Galveston; the bascule bridges were constructed by George O. Reed Co. of Michigan City, Ind. All of the work is now completed except a portion of the roadway paving. At the contract prices the embankment portion of the causeway will cost $23 per lineal ft. while the viaduct portion will cost $70 per lineal ft. exclusive of engineering, legal or other administration expense. The total cost of the work is $650,000. At present prices for materials and labor these costs would be doubled at least.

Klyce and Kackley of Nashville, Tenn., and Miami, Fla. are the engineers with Wm. E. Wilbur as resident engineer.

HOW CITIES OF NEW YORK STATE DEFEATED EFFORTS OF STREET RAILWAY COMPANIES TO ESCAPE COST OF CAR TRACK PAVING.

By William P. Capes, Director of State Bureau of Municipal Information of the New York State Conference of Mayors and Other City Officials, 25 Washington Ave., Albany, N. Y.

(Editor's Note:—A movement, nation-wide in its scope, has been started by the street railway companies to repeal or modify laws and franchises requiring street railway companies to construct and maintain the pavement between, and a certain distance on either side of their tracks. How the effort was defeated in New York State by the cities will be of interest to the cities of other states. The present article by Mr. Capes gives a summary of the arguments which the cities used before the State Legislature in opposition to the bill presented at the latest session.)

As a result of a nation-wide agitation by street railway companies, public service commissions and other similar regulatory bodies in a number of states have, within the last year or two, recommended that state laws and local franchises, requiring traction companies to construct and maintain pavements between and a certain distance on either side of their tracks, should be changed, so as to relieve the corporation of this expense. Among the state bodies making such a recommendation was the Public Service Commission for the Second District of New York. In its last annual report to the Legislature it said:

Recommendation Made by Public Service Commission for the Second District of New York

"The attention of the Legislature is directed to those provisions of section 178 of the Railroad Law which require street surface railroads to have and to keep in permanent repair that portion of any street, avenue or public

place between its tracks, the rails of its tracks and 2 ft. in width outside of its tracks. In nearly all cities it has been necessary to increase the rates of fare on street railroads, so that the 5-cent fare formerly in common use has been largely superseded by higher rates. The commission is of the opinion that it is highly desirable to return as soon as possible to the 5-ct. fare. Increased fares tend to decrease the volume of travel, and it seems evident that in such case the passengers who discontinue the use of street car facilities must in large part comprise that element of the community which most feels the deprivation. The requirement of street paving and repair in the statute referred to constitutes a very heavy financial burden on the urban line, which, of course, must be recouped out of earnings. We beg to point out that the conditions which gave rise to this statutory requirement have, at least in the larger communities, for the most part passed away. At the time of the imposition of this burden there was little or no construction of the present so-called permanent type of either track, track support, or pavement. With the cobble or sand stone pavements of that day, laid on sand, there was a strong tendency for those in charge of horses and vehicles to make use of the track as the smoothest part of the roadway. The result was the rapid disintregration of that part of the pavement contiguous to the rails, for which naturally the railroad company was held responsible. It will be recalled that at that period street cars were universally drawn by horses, and the use of the pavements between the tracks by such horses was very great, and contributed in large degree to the wearing out of the pavements. With the present heavy construction of both railroad and pavement, supported by concrete, and the substitution of motors for horse-drawn vehicles, these conditions have largely ceased to exist. We therefore believe that the Legislature could with justice require the modification of this requirement."

This summarizes the arguments that have been presented by the traction corporations in support of their contentions that they should be relieved of this item of expense.

Following this report the New York State Street Railway Association drafted and introduced into the Legislature a bill providing that traction companies be required to construct and maintain the pavement for only 6 ins. on either side of their rails in streets occupied by street railroad tracks. The law, which the association proposed to amend, requires the companies to construct and maintain the pavement between and for 2 ft. on either side of their tracks.

Cities Opposed Proposed Amendment

Through the New York State Conference of Mayors and other city officials, the 59 cities in the state opposed the proposed amendment. At the request of the chairman of the Senate Committee on Public Service, to which the bill had been referred, each city through its mayor and city engineer, filed a brief giving the reasons for its opposition.

The committee also received a report from the New York State Bureau of Municipal Information summarizing the data it had received from 166 American cities of 30,000 or more population. The report showed that of these cities 60 required the street railway companies to pay for the construction, reconstruction and maintenance of pavement (original, repavement, temporary and permanent) between and for 2 ft. on either side of their tracks. In 15 other cities the companies are responsible for the pavement between and 18 ins. on either side of their tracks, and in 11 others for 12 ins. on either side of their tracks. The plans vary in the remaining cities, but in all, except one, the companies are held responsible for the pavement of at least that part of the street occupied by their tracks.

The arguments presented by the cities in their briefs were so numerous and sound and so completely refuted the statements by the Public Service Commission that the bill was never reported by the Senate Committee.

As an aid to the cities in other states where efforts may be made to transfer the burden of paving expense from the traction corporations to the cities or abutting property owners, the New York State Bureau of Municipal Information has prepared the following summary of the arguments presented to the Legislature in the briefs submitted by the New York State cities:

Summary of Arguments Presented by Cities

1. The standard type of railroad construction in streets consists of laying wooden ties every 24 ins. apart on its sub-grade. Its ties are 6 ins. in width, 8 ins. in breadth and 8 ft. in length. On the ties are placed rails which are 4 ft., 8½ ins apart. These rails are held together every 16½ ft. of track with splice bars bolted to the rails, and over-lapping the splice bar is a bonding wire transmitting current to the rails.

2. The ties project 20 ins. outside of the rail and the bonding and splicing bar more than 6 ins. in many cases. In a street where double tracks are maintained, the space between the double tracks, usually called the "dummy track," is 56 ins., and with the tie spacing and tie extension as mentioned above, 40 ins. of this space is occupied by railway ties.

3. Heavy urban cars, and not the ordinary travel, are responsible for constant repair to pavements.

4. The weight of the modern electric car is from six to ten times the weight of the horse car formerly used. This weight produces a correspondingly increased vibration. As the wheels of the cars become flattened or otherwise defective, the vibration is tremendously increased. Vibration necessarily tends to disintregrate the material of which the pavement is constructed, and the greater the vibration the greater will be the disintregration. In addition, the railroad companies insist on running cars over tracks while the pavement is under construction, so that a complete bonding of the materials is seldom obtained. This causes a weak point in the pavement, not only along the rails but for the entire length of the ties (usually 8 ft. 6 ins.) In cities where the combined load of car and passengers is approximately 25 tons, it is self evident what happens to that portion of the pavement over the ties and ballast of the railroad company. The injury to the pavement from vibration is infinitely more destructive than any surface wear that could be produced by the travel of horses.

5. The old cobble stone and sandstone pavements used when horse cars were operated, were porous and the penetration of water into the sub-grade was unimportant. The modern hard surface pavement is of rigid construction, and requires for its preservation that the surface

be impervious to water. No pavement can be laid as securely with rails spaced at intervals at the center of the street with the same length of life as on a street which is free from rails. The contour of the street must be altered to provide for drainage along and adjacent to the rails, and the inability of any roadbed construction to withstand the seepage of water into it by creeping along the rails is well known. Water is the enemy of pavement, and the rails provide a means for the water to enter underneath the pavement, undermining it and causing it to heave or rot depending upon the nature of the paving material. The same degree of drainage cannot be provided on streets on which car tracks are operated as can be afforded on streets which have no car tracks. The rail affords the first opportunity for the water to enter the sub-grade. It forms the first point of weakness in the pavement. It is, therefore, the point at which the pavement shows first signs of decay. On Castle street, in the city of Geneva, upheavals from this cause have occurred during the present spring between the tracks for a distance of 15 ft. outside of them. The weight of traffic over the pavement in this upheaved condition results in a most destructive collapse or breaking up of the pavement.

6. It is impossible to maintain any modern satisfactory pavement adjacent to any car track construction unless such track construction is made right. The incentive to make such rigid construction now rests with the traction company to lessen the cost of pavement maintenance. With such incentive for the more expensive track construction removed, the company would naturally resort to a cheaper track construction, resulting in an increased cost of pavement maintenance, or would make such pavement most difficult if not impossible. The enforcement of pavement maintenance under the present law works practically to compel proper track construction as such provision, when in force, makes economical the proper track construction and maintenance. No relief from present obligations can be reasonably considered except in conjunction with thorough control of track construction and maintenance by the municipalities without soon creating an impossible condition of street pavement maintenance.

7. In case the company is to construct a track in a street already paved, it becomes necessary to tear up at least 9 ft. of pavement in order to lay the tracks. This pavement has already been paid for once, and it may be relaid after the tracks have been placed in such a way that it is apparently on the surface, as good as new, but there is a longitudinal crack in the base which eventually works toward the surface under the stress of constant vibration. This in a short time would mean constant repair.

8. In the case of replacing of ties, etc. by the railroad company, it is necessary to take up and replace a strip of pavement approximately 9 ft. wide. This is a charge which in all fairness should be paid by the railroad company. Long before the expiration of the life of the roadbed the railway company is compelled to disturb the pavements to shim joints, renew bonds, replace broken rails and retighten joints, and in performing this service it is necessary to disturb 20 ins. of pavement in order to make working room for men and their tools. It is found necessary to renew ties, even though they be bedded in concrete, before the pavement has served its life.

9. The constant tearing up of the pavement to repair car tracks is very detrimental to the condition of a street. A pavement which has been torn up cannot be restored to as good condition as before, consequently the location of railway tracks in a street necessarily tends to destroy the life of the whole pavement.

10. General street railroad engineering has established the fact that repairs to paving in the railroad area consume 17 to 20 per cent. of the total cost of maintenance of way, so a reduction of seven-ninths of this obligation would not help the railroad company more than the additional cent charged in a 6 ct. fare.

11. The life of the roadbed of a railroad company is about twelve years and the life of a durably constructed pavement is over twenty years.

12. It is a well known fact among engineers that no matter how well a pavement is constructed, it will heave along the rail line and does not settle back in the spring as it should. Each year increases the degree of this trouble. This cannot be attributed to vehicular traffic for in these days the majority of vehicles are motor driven, which usually means rubber tires, and it is the practice of most good drivers to keep as far from the rails as possible, if for no other reason than the protection of tires. It is also well known that street railroad companies use quantities of salt around switches in the winter time and this has a very serious effect on pavements.

13. The life of a pavement on any street in which street cars are located is reduced 50 per cent. As an illustration of this fact refer to Genesee street in Albany. There are no cracks from Castle street to Lewis street, and the pavement on this part of the street is in excellent condition, while the pavement on the rest of the street, in which tracks are located, is now in such condition that immediate repavement is necessary although both parts of the street were paved at the same time and with the same kind of pavement.

14. Defective rails cannot be properly removed and replaced in a 1 ft. area, particularly on curves.

15. Cities should not be required to pay for the cost of greater excavation and heavier construction required under tracks, which are necessarily purely for the support of a company's cars.

16. The presence of street railway tracks in a street necessitates a special and more expensive construction of pavement. It is necessary to make the concrete foundation 8 ins. to 10 ins. in depth between the tracks and at the side of the tracks, instead of 5 ins. in depth, as in other parts of the street. This special construction has to be carried the full width of the ties (8 ft.) and 6 ins. beyond on each side, making a total width of 9 ft. for a single track. As the railway companies now use T-rails instead of flange rails, this necessitates the use of a special type of brick on the inside of the rails, which is more expensive than the regular paving brick. The fitting of these bricks to the rails also involves additional expense in laying the pavements.

17. The presence of railway tracks requires an increased width of the pavement. This is necessary in order to permit traffic on both sides of a car. Our residence streets are ordinarily paved 24 ft. in width, but in

a street in which a single railway track is located, we consider that a pavement of 36 ft. in width is necessary. Under the present law the railway company does not pay the whole cost of this additional width. It would be most unjust to throw a greater share of the cost on the property owners when the necessity for the additional width results entirely from the use of the street by the railway company.

18. In repairing or connecting with water or sewer mains, it is often necessary to excavate under the tracks while cars are in operation at a considerable additional expense over what such work would cost in streets where there is no street car traffic. Property owners likewise in laying sewer or water laterals are burdened with similar extra expense.

19. The usual method of proceeding with paving work is by incurring a funded debt on the part of the city for its portion of the expense, and if the roadbed of the railroad company, which has a life of only about twelve years, is to enter into the issuance of bonds by the municipality, which usually extend over a period of 20 years, it will demand of the railroad company such a type of construction as will clearly outlive the issuance of bonds. Our experience with the methods of track construction used by street railway companies in paved streets, is that they are of an inferior character, and have subjected the city to an expense which would not have been encouraged had no tracks existed on paved streets.

20. In cities where large snow falls must be anticipated, the operation of snow plows and snow sweepers tends to break down the pavement between the rails. We maintain that the city should not be asked to correct conditions due to the operation of plows and sweepers.

21. It is fallacious to believe that the conditions existing today relative to the destructive influence of trolley tracks and the operation of trolley cars over them, is not the same as it has always been. The traction companies' false idea of economy, in general, has been a reduction of the first cost in ballasting of their tracks. This in conjunction with the rapidly increasing weight of cars, has extended the circle of influence of destruction more than 2 ft. outside the outside rail.

22. If the traction companies are relieved of this obligation, the increased cost of pavement and repair is thrown back on property owners by assessment for local benefits derived, or, if a general improvement, new revenue has to be obtained by an increase of the general tax. If it is a question of financing the work, surely the railroads, and indirectly the people who use them and benefit therefrom, should stand this cost, and not the entire community. Not over 50 per cent. of the population have occasion to use the railway, and it does not seem proper to ask those who derive no benefit therefrom, to help pay for the construction and repair which would be the case if there were a charge on the city.

23. The statute which it is proposed to amend is fair to the railway company in that the area of street pavement which it is now obliged to maintain is that area within which experience of many years has shown the street pavement is particularly affected by the maintenance and operation of its lines.

24. The presence of space between the tracks limits the surface area of the street available for traffic, and distributes over that portion of the street outside of "the dummy," more traffic than would ordinarily come on it, so that the practical result is that the railroad companies appropriate to their exclusive use that portion of the street between the tracks where the trolley poles have been installed betwen them.

25. In the borough of Manhattan in New York City all of the street surface railroad companies are operated with the underground electrical system which requires the installation of so called "channel" or "slot" rail in the middle of the space between the two rails of each track so that in the center of the space between the rails which, under the proposed bill, the city would be obliged to repair, we have a railroad structure the maintenance of which requires constant interference with the pavement between the rails and the tracks, and we have, further, manhole boxes, so-called, every few feet, approximately a foot square, the metal cover for which is located in the space between the slot or channel rail and rail of the track. These covers when placed opposite to each other on either side of the channel rail, as they frequently are, occupy almost the entire space between the two rails of the tracks. In the type of construction to which we have referred it will be readily seen that the pavement between the rails of the tracks is divided by the railroad structure into oblong strips or a series of small patches. These railroad structures tend greatly to diminish the life of the pavement. The traffic in the city of New York is very heavy and when the wheels of a heavily loaded vehicle pass from the metal structure of the railroad companies onto the pavement there is a grinding or wearing effect on the pavement which, being softer than the metal structure, is soon ground and worked away. Ruts, holes and depressions first appear in the pavement immediately adjoining the rails of the tracks and by the traffic are generally extended so as to include the entire space between the rails of the tracks and several feet outside of the outer rails of the tracks.

26. Snow and ice, cleared from the trackway, are thrown outside of the rail and often must be carted away by the city. With no tracks in the street, the snow ordinarily would remain evenly spread over the entire width of the pavement and not require removal.

27. Nine feet, a dimension controlled by the 8 ft. railroad tie should be definitely marked off by construction joints, and 9 ft. built and maintained by the railroad company. This places entire responsibility for damages due to subsequent failure within the railway strip where it belongs, since failure is due to railroad traffic.

28. If expense for pavement adjacent to rails and 2 ft. outside has heretofore been deemed a legitimate charge to street railway companies, a change is not considered justifiable now in the light of the usage of the heavy cars, higher speed and more frequent operation.

29. A railway company is constantly ripping up pavements to repair its street car tracks. It is absolutely impossible for a company, were it to maintain only 6 ins. in width on each side of its rails, properly to repair its tracks without disturbing other parts of the pavement, thus necessitating an added expense to be borne by the city.

30. The cities upon the faith of the performance by the street surface railroad corporation of their paving

obligations have granted many franchises on terms more favorable to street railroad corporations than they would have imposed had they not assumed that such railroad corporations would be obliged to pave the area described in existing law. If the liability on the part of the traction company existed then, there has been nothing that has taken place in the meantime to offset this liability, except to increase it.

31. The original purpose of this law was to place the burden of expense of this portion of the pavement upon the street railway company which enjoyed the privilege of the use of the streets to operate a business from which it derives a revenue. Nothing has transpired since the law was enacted which justifies a change which would place the burden of expense upon the taxpayer.

FEDERAL AID FUNDS WHICH MUST BE ABSORBED DURING THE FISCAL YEAR 1920 OR TAKEN UP

When the Congress of the United States made the first appropriation for Federal Aid for road-building, one of the provisions enacted was that the funds appropriated for any given fiscal year must be taken up within that fiscal year or the next one succeeding. It, therefore, transpires that once every year the question is raised as to whether all of the funds that have been made available have been absorbed by the States. During previous years this question has been of comparatively little importance because the amount of Federal Aid was relatively small and the probability of any State failing to take up its share, remote. However, when Congress added to the original appropriation the sum of $200,000,000 of which $50,000,000 was made available for the fiscal year 1919, and therefore had to be taken up prior to July 1, 1920, a real test of the ability of the States to absorb Federal Aid funds was established. It is not without significance that the States have taken up these funds more promptly than the smaller sums available during any previous year and that on June 16, 1920, the Chief Engineer of the Bureau of Public Roads signed the last plans and estimates needed in order to absorb the full allotment for the last States in the Union.

Table I which shows the amount of Federal Aid funds so far covered by plans and estimates is also of interest because it shows that, not only had all of the Federal Aid which had to be covered prior to July 1, been covered, but that a very large part of the 1920 funds have also been covered. Indeed this table shows that eight of the states have taken up all of the funds now available and that seven of these have obligated a portion of the funds that do not become available until after the first of July. This is, indeed, a wonderful showing and fully justifies the often expressed opinion that Federal Aid is appreciated by the States and is being absorbed fully as rapidly as the Federal Aid acts have contemplated.

Some impression of the rate at which Federal Aid is being requested may be secured from the following. During April new projects were submitted which called for Federal Aid amounting to $9,779,857.21 and plans and estimates were approved that called for $8,014,949.89 of Federal Aid. In May new projects were presented for approval that called for $7,719,689.15 of Federal Aid and plans and estimates were submitted on previously approved projects which required $16,656,872.35 of Federal Aid. During the first half of June new projects were submitted asking Federal Aid to the amount of $3,757,701.79 and plans and specifications were approved by the Chief Engineer calling for Federal Aid to the amount of $7,832,630.87.

The efficiency of the present organization of the Bureau of Public Roads can be no better indicated than by the fact that this enormous volume of business, amounting at times to the handling of requests for Federal Aid that amounted to more than a million dollars a day, has been transacted by the office of the Chief Engineer without the slightest delay and without omitting in any case, the necessary examination and correction of plans. Still better conception of the work of the Bureau of Public Roads and of the splendid organization which has now been developed can perhaps be had from the fact that while this work was being looked after the Bureau was also giving attention to the construction of more than 1,800 projects involving the building of some 18,000 miles of improved highways. This, in itself, is a tremendous operation demanding the careful attention of a large corps of trained engineers and the guidance of executives of the highest order. It may, therefore, be truthfully

TABLE I—STATUS OF FEDERAL AID FUNDS ON JUNE 16, 1920

State	Funds which must be taken up prior to July 1, 1920.	Funds obligated by plans and estimates approved by Chief Engineer of the Bureau of Public Roads.	Balance to be taken up prior to July 1, 1920.	Funds which must be taken up prior to July 1, 1921.	Balance which remains of funds to be taken up prior to July 1, 1921.
Alabama	1,676,167.27	1,714,967.74	0	3,671,669.07	1,956,701.33
Arizona	959,097.68	970,074.38	0	2,397,707.53	1,427,633.15
Arkansas	1,338,315.29	1,301,127.53	0	2,934,751.38	1,633,623.85
California	2,433,607.29	3,060,552.46	0	5,329,679.06	2,269,126.60
Colorado	1,375,920.25	1,450,904.21	0	3,024,304.97	1,573,400.76
Connecticut	492,552.43	981,823.05	0	1,075,975.27	94,152,22
Delaware	130,349.56	284,980.01	0	284,980.02	.01
Florida	912,449.89	1,476,917.40	0	2,002,664.56	525,747.16
Georgia	2,152,942.64	4,067,844.55	0	4,710,427.66	642,583.11
Idaho	974,371.32	1,003,107.46	0	2,134,338.93	1,131,231.47
Illinois	3,506,652.82	10,484,154.61	0	7,659,199.06	0
Indiana	2,163,392.46	2,330,279.49	0	4,728,239.34	2,397,959.85
Iowa	2,316,226.61	5,318,649.70	0	5,058,014.40	0
Kansas	2,295,068.00	4,888,460.41	0	5,024,064.45	135,604.04
Kentucky	1,562,265.53	1,614,538.20	0	3,418,309.36	1,803,771.16
Louisiana	1,086,908.29	1,918,464.93	0	2,380,293.44	461,828.51
Maine	771,393.47	1,056,827.77	0	1,685,733.41	628,905.64
Maryland	697,750.11	1,691,116.43	0	1,523,750.46	0
Massachusetts	1,179,698.00	1,600,470.81	0	2,579,776.26	979,305.45
Michigan	2,319,921.34	3,309,422.02	0	5,069,627.58	1,760,205.56
Minnesota	2,273,822,10	3,662,728.41	0	4,973,293.69	1,310,565.28
Mississippi	1,434,957.40	1,590,182.62	0	3,143,985.12	1,553,802.50
Missouri	2,713,079.31	3,049,093.49	0	5,934,176.11	2,885,082.62
Montana	1,592,849.60	1,508,854.18	0	3,491,837.18	1,982,983.00
Nebraska	1,706,399.75	3,451,947.98	0	3,733,019.68	281,071.70
Nevada	1,029,358.18	1,081,665.09	0	2,250,931.75	1,169,266.66
New Hampshire	333,410.35	790,690.56	0	728,250.06	0
New Jersey	949,046.06	1,454,849.23	0	2,077,742.57	622,893.34
New Mexico	1,273,633.77	1,307,676.17	0	2,791,326.76	1,483,650.59
New York	3,989,791.41	4,213,480.30	0	8,716,908.56	4,503,428.26
North Carolina	1,825,679.69	3,127,560.01	0	3,991,636.88	864,076.87
North Dakota	1,226,375.37	1,256,560.95	0	2,686,259,90	1,429,698.95
Ohio	2,973,222.17	5,446,803.36	0	6,496,700.90	1,049,897,54
Oklahoma	1,844,961,83	1,889,799.50	0	4,035,767.27	2,145,967.77
Oregon	1,259,853.95	3,320,163.83	0	2,756,026.23	0
Pennsylvania	3,678,154.13	9,624,353.12	0	8,040,698.24	0
Rhode Island	186,500.46	403,834.79	0	407,909.26	4,074.47
South Carolina	1,147,734.06	1,538,526.76	0	2,510,598.46	972,071.70
South Dakota	1,134,842.29	1,155,215.65	0	2,837,103.60	1,681,887.95
Tennessee	1,815,227.44	2,683,406.00	0	3,966,224.08	1,282,818.08
Texas	4,095,133.88	4,162,884.20	0	10,238,806.31	6,075,992.11
Utah	909,205.72	985,775.02	0	1,987,630.72	1,001,855.70
Vermont	362,650.02	476,240.16	0	792,026.64	315,786.48
Virginia	1,589,155.85	2,250,133.01	0	3,474,056.45	1,223,923.44
Washington	1,154,550.27	3,365,604.27	0	2,527,048.04	0
West Virginia	851,534.38	2,008,040.76	0	1,862,351.68	0
Wisconsin	2,040,736.93	2,208,988.16	0	4,459,335.32	2,250,347.16
Wyoming	980,308.68	1,447,678.68	0	2,144,842.33	697,163.65

stated that the organization of the Bureau has now reached a point of great efficiency both in administering the distribution of Federal Aid and in the Field Inspection of construction work and that through the efforts of the heads of this organization, Federal Aid is now being shown to be a complete success.

ADVANTAGES OF CENTRALIZED MUNICIPAL PURCHASING

By C. A. Bingham, City Manager, Watertown, N. Y.

The purchasing of all municipal supplies by one central office accomplishes many good purposes, and this article will deal with them, in the order of their value to the average municipality.

Eliminates Waste.

(a) The purchasing Agent keeps the perpetual inventory of all departments, as a check against overstocking, as well as under supplying.

(b) Each order is signed by the Auditor or Controller, and finally by the Mayor or Manager, thus centralizing the usual scattered responsibility.

(c) Transfers from departments over-stocked to those under supplied is better accomplished through one central office.

Eliminates Over-Drafts

(a) Every outstanding order is on record at all times, while without such centralization, thousands of dollars are in unrecorded obligations, thus preventing a true financial statement, as well as encouraging deficits toward the end of the year, to be passed on to the incoming administration.

(b) Prior to executive approval, each order is placed as an encumbrance against its particular appropriation by the auditor, like a certified check; thus making over-draft impossible, as well as insuring funds for its prompt payment.

(c) The executive who is held responsible for the City's finances should of course, have the executive control of the purchases, which cannot be efficiently carried out, when a score of departments do their own purchasing.

Secures Lowest Prices

(a) It is common knowledge, and most any seller will admit that centralized and combined purchases will bring lower prices and quicker deliveries, than many small purchases. There is abundant proof on record in our cities, where one department is paying 33 to 100 per cent. more for the same make of goods, than another department, and often even when purchasing from the same dealer.

(b) The average city takes a month or more to audit and pay a bill, not only losing all cash discounts, but also discouraging keen competition on quick turnovers, whereas by centralized purchasing, minus red tape, a bill can be paid in ten minutes, and special concessions of as high as 10 per cent. are frequent.

(c) By a systematic record of annual requirements for all departments, the purchasing agent is at all times prepared to clinch an attractive proposition, due to seasonal or market conditions, as well as arranging deliveries, so as not to tie up money unnecessarily, and yet assure a satisfactory supply at all times.

Reduces Expenditures

(a) By knowing that his executive passes on all requisitions a department head will not want to buy as much as he might, if he felt there was no check upon him.

(b) Efficient purchasing and inspection assures first grade of materials, as well as full measure—otherwise the seller knows he will receive no repeat orders.

(c) The joint knowledge and experience of the department head, the purchasing agent, and the executive often leads to either the securing of a better article on first cost or a substitute where the same would fill the need, while if the department head had to rely on his own decision entirely, the wrong selection might more often be the result.

Eliminates Graft

(a) If the purchasing agent is selected by merit, rather than by politics, he will be of the class above grafting. A real purchasing agent always has his advancement in view, and knows that one dishonest act will wreck his entire future.

(b) Sellers are generally afraid to even suggest graft to a municipal purchasing executive for fear of losing all future chances to sell to him.

Saves Taxpayers' Money

(a) The salary of the full-time purchasing agent is much less than the aggregate amount of hours wasted during a year by all the score of higher priced officials, who are forced to worry over such details in our average cities, not to mention the time lost from their real capacities.

(b) A large number of cities now maintaining centralized purchasing departments have proven that the 2 per cent. discount for payment of bills within 10 days, more than offsets the salary of the official. This 2 per cent. in 10 days is equivalent to 36 per cent. a year, but it is an unheard of and impossible proposition in the great majority of our American cities, simply because of antiquated systems, that no business concern would think of using.

(c) The trade discounts which are available, but are being passed up by our cities are astounding. In one city of under 40,000 these discounts totalled nearly $20,000 in one year; in another larger city it was $33,000, and in one of our second ten cities it was $100,000.

In General

In these days price is often the second question, delivery being of prime importance. Here surely none can deny the advantage of centralized purchasing. A follow-up system on all out-standing orders, a tickler on tardy invoices, a knowledge of available sources of supply, and lastly a constant touch on transportation, embargoes, etc., can not be compared with the lack of anything resembling system under the old order.

Forms play a most important part in efficient purchasing. First there is no need of the six to ten copy sets so often seen, for by a proper system several copies can be made to work double purpose. On the requisition, quotation and invoices the original and one copy only is

required; and for the other, the original and three copies will answer every need that can arise.

The forms for order, supply and quotation records, requisition index, etc., can all be accommodated on 4x6 in. cards. Not once in ninety times do we find need of more than ten double spaces on an order sheet, yet we find cities still wasting money on large and unweildy order forms. For filing purposes especially, all forms should be of uniform size, but of varying colors. Half letter size will be found to work best for all purposes, and as just one example can be cited the fact that several thousand invoices of that size can be vertically filed in a single small drawer, and always in immediate reach, while the cities still backing up vouchers of all sizes from 2 in. to legal cap, will soon have to use stepladders to do their filing.

The foregoing paper by Mr. Bingham was presented before the recent New York State Conference of Mayors and other city officials.

EFFECT OF HYDRATED LIME AND OTHER POWDERED ADMIXTURES IN CONCRETE

By Duff A. Abrams, Structural Materials Research Laboratory, Lewis Institute, 1951 W. Madison St., Chicago, Ill.

(Editor's Note:—A summary follows of the paper on this subject presented by Prof. Abrams before the annual convention of the American Society for Testing Materials held at Asbury Park, N. J., June 22-25, 1920.)

Studies of the effect of hydrated lime and other powdered admixtures in concrete have been under way in this laboratory during the past four years. About 20,000 tests have been made in six different investigations.

Compression tests of hand-mixed concrete were made on 6 by 12-in. cylinders in which hydrated lime was added in quantities up to 50 per cent. of the volume of the cement. In one series, tests were made with 17 other powdered admixtures. The mix varied from 1:9 to 1:2, with wide variations in consistency and size and grading of aggregate. The age at test varied from 3 days to 1½ years. Wear and bond tests were made in certain groups. Tests were also made with sand and slag cements.

Conclusions

The following are the principal conclusions:

1. In general the addition of powdered materials reduced the strength of concrete approximately in proportion to the quantity of admixture. Some exceptions are noted below.

2. In usual mixtures, each 1 per cent of hydrated lime (in terms of the volume of cement) reduced the strength of concrete 0.5 per cent.; 1 per cent. by weight of cement reduced the strength 1.2 per cent. The reduction in strength caused by replacing cement with an equal volume of hydrated lime was about 1¾ times that caused by adding hydrated lime.

3. High calcium and high magnesium limes produced the same effect.

4. The addition of 1 per cent of the following powdered admixtures in terms of the volume of cement reduced the strength of 1:4 concrete at 28 days by the following percentages: Brick, 0.08; clay, 0.22; whiting, 0.24; sand, 0.37; natural cement, 0.38; limestone, 0.39; lava, 0.40; fluorspar, 0.43; kaolin, 0.47; kieselguhr, 0.48; tufa, 0.51; hydrated lime, 0.56; ironite, 0.60; yellow ochre, 0.68; mica, 1.10; pitch, 1.50; gypsum, 4.00. For the same conditions the addition of 1 per cent. of cement increased the strength of concrete about 1 per cent.

5. Pulverized slag up to 50 per cent of volume of cement gave a slight increase in strength of concrete (about 0.12 on the basis used above.)

6. Rich concrete mixes showed a greater loss in strength due to powdered admixtures than the leaner ones. Very lean mixes (1:9 to 1:6) and in those with aggregates graded too coarse for the quantity of cement used, the strength was little affected or was slightly increased by admixtures up to 50 per cent.

7. The wetter mixes showed a greater loss in strength than the dry, due to the addition of hydrated lime.

8. The effect of admixtures was in general independent of the age of the concrete.

9. Sand and slag cements gave results comparable to those from powdered materials simply mixed in the concrete.

10. Hydrated lime and other powdered admixtures used in these tests slightly increased the workability of the leaner mixes (1:9 and 1:6) as measured by the slump test. Ordinary mixes (1:5 and 1:4) were little affected; richer mixes (1:3 and 1:2) were made less plastic.

11. The wear of concrete was not sensibly increased by hydrated lime or other admixtures up to 20 per cent. of the volume of cement.

12. The bond resistance was affected in the same manner as the strength by the presence of hydrated lime.

13. Hydrated lime had little effect on the absorption of dry concrete, increased the evaporation of water from wet concrete and produced no beneficial effect on the strength of concrete stored in air.

14. The yield of concrete was little affected by hydrated lime or other admixtures; for the usual concrete mixes, 20 per cent admixture increased the yield about 2.5 per cent.

LAST SECTION OF RICHMOND, VA.-WASHINGTON, D. C., HIGHWAY IMPROVED WITH GRAVEL ROADWAY

By C. S. Mullen, District Engineer, Virginia State Highway Commission, State House, Richmond, Va.

The particular interest attaching to Virginia Project No. 2 is the fact that it was the last section of the Richmond-Washington Highway to be improved.

For over ten years the Richmond-Washington Highway Association had been directing its energies to the construction of an improved road between Richmond and Washington, and by the year 1916 the entire route had been graded and surfaced except for a section just south of Woodbridge, about four miles in length. This section, designated as Marumsco Creek to Neabsco Creek was constructed as Virginia Project No. 2.

Agitation was started in December, 1916, to make this a Federal Aid Project under the new law appropriating

VIEWS OF VIRGINIA PROJECT NO. 2. BETWEEN RICHMOND AND WASHINGTON, D. C.
Right of Way Cleared—Roadbed Graded—The Gravel Roadway in Service.

Federal Aid for construction of post roads, and during the following spring of 1917 this work was urged as a measure of national defense to give the United States Marine Corps a satisfactory roadway for the transportation of supplies by trucks between Washington, D. C., and their base at Quantico, Virginia. With this added impetus the construction of this road was gotten through as Virginia Project No. 2 and construction started about the middle of the summer. Progress from the first was very slow and affairs eventually reached such an unsatisfactory state that the arrangements for carrying on the work were cancelled and all activities were suspended on December 6, 1917.

Early in 1918 the revival of this project was undertaken but it was not until the latter part of December, 1918, that satisfactory arrangements were made and a contract let to the S. E. Lee Construction Company of Emporia, Virginia, for the improvement of this section of road. The work included grading the entire project, building three small concrete bridges, putting in the necessary cross drains and underdrainage, and surfacing the roadway with gravel 16 ft. in width and 8 ins. in depth.

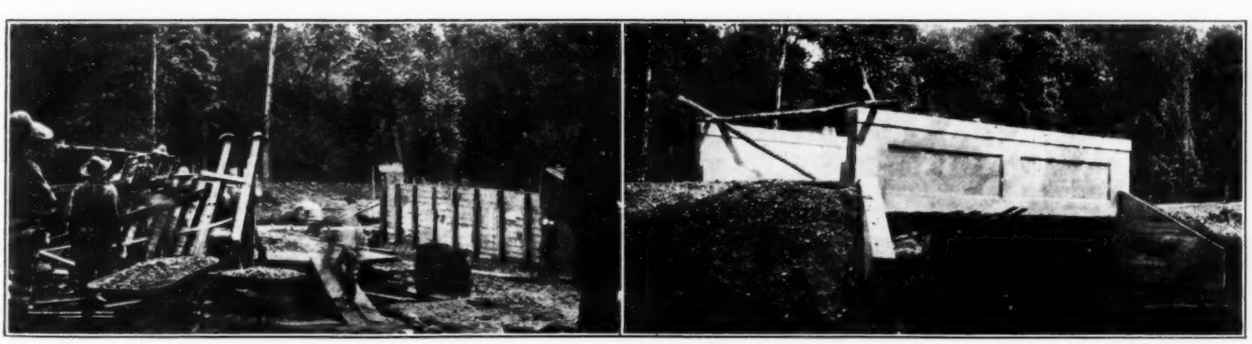
First Virginia Job to Use Government Trucks

One very interesting phase of this work was that it was the first job on which use was made of trucks which had been turned over to the State by the War Department. The contractor was supplied with four 2-ton Nash Quad trucks for which he paid a reasonable monthly rental. These trucks were equipped with dump bodies and the use of them was a distinct aid in carrying on this work.

Work under this contract was started early in January, 1919, and excellent progress was made, taking into consideration that the work was done during the hardest part of the winter.

Trouble With Gravel Supply

Under the terms of the contract this was to be completed by July 1, but during the summer considerable trouble developed in getting a sufficient supply of suitable gravel for the surfacing. Local gravel was used for the base but it was necessary to import gravel for the surface. A tie-up of the car service prevented an adequate supply of gravel being shipped in and after this shortage was relieved the character of the gravel received was not satisfactory and other arrangements had to be made. During this period an attempt was made to haul gravel from a pit seven miles away. Unfortunately the road over which this material was to be hauled was unimproved and in many places soft, due to springs, and the heavily loaded trucks soon buried themselves to the axle and this pit had to be abandoned, since it would have required too large an expenditure to put the road from the pit to the project in shape to haul over. Recourse was again had to gravel shipped in from one of the commercial pits in that section, and about the middle of December, 1919, the project was finally completed. Although opened to traffic in the middle of winter, this road gave good service and eliminated the worst barrier to automobile traffic between Richmond and Washington.



STANDARD 20 FT. CONCRETE SLAB BRIDGE UNDER CONSTRUCTION AND COMPLETED ON VIRGINIA PROJECT NO. 2.

SUGGESTED COMPOSITE SPECIFICATIONS FOR CONCRETE ROADWAY CONSTRUCTION

By S. M. Feinberg, C. E., Public Works Office, U. S. Navy Yard, New York, N. Y.

The following is a slightly modified copy of a specification the writer has prepared for a piece of concrete pavement and sidewalk construction. The specification as presented is a compilation from various up-to-date sources, such as the American Concrete Institute, the New York state and other state and federal authorities, supplemented by the personal experience of the writer.

It is the opinion of the writer that this is an iron-clad specification and it is offered to the profession through MUNICIPAL AND COUNTY Engineering in the hope that it may prove of benefit to those interested in concrete roadway construction:

Clearing

Work Required—Work required includes the removal of all trees, old pavements, sidewalks, curbing, manholes, catch basins, flagstones, and any other material and appurtenances of whatever nature coming within the lines of the roadways and sidewalks that may interfere with the proposed work.

Removed Materials—Removed materials, with the exception of such as are hereinafter mentioned as reserved, shall be burned or otherwise removed from the ground as the engineer in charge may direct and without injury to adjoining property.

Reserved Material—All trees and branches over 3½ ins. in diameter, unless noted otherwise, shall be reserved for the city, and shall be trimmed of leaves and branches and piled to one side of the road as the engineer in charge may direct.

Movable Property—All movable property interfering with the construction of the roads and walks shall be carefully removed or piled up as directed by the engineer. No property shall be taken down except by the authority of the engineer.

Grading.

Work Required—Work required includes all excavation of materials and the placing of excavated materials in fill or backfill as directed by the engineer; the preparation of the subgrades so as to bring the surfaces to required grade (allowing for compression from rolling); also all similar work connected or appertaining to the construction of the roadways and sidewalks.

All fill material required in excess of that available from trenches, cuts, or from such other places on the premises as the engineer may direct shall be provided by the contractor.

Fill and Backfill—Fill and backfill shall be of good earth material free from vegetable matter and refuse. The use of muck, quicksand and spongy material that will not consolidate under the roller will not be permitted.

When the forms have been removed and the concrete thoroughly set, the contractor shall backfill along edges of all roadways, sidewalks and curbing to required grade. All backfill shall be thoroughly compacted and settled into place.

Preparation of Surfaces for Fill—All low places requiring fill shall be plowed or dug up to provide bond for fill if required by the engineer.

Surplus Excavated Material—Surplus excavated material shall be deposited by contractor where and as directed by the engineer at points within 500 ft. of its place of removal.

Subgrade—Subgrade for roadways and sidewalks shall be rolled by a power roller weighing not less than 10 tons. Use weight of roller desired to suit local conditions. After the subgrade has been carefully prepared, thoroughly compacted throughout and drained, all portions of the subgrade inaccessible to the roller shall be thoroughly tamped with a hand tamp weighing not less than 50 lbs., the face of which shall not exceed 100 sq. ins. in area. All soft spots that cannot be compacted by rolling must be removed and replaced with suitable material. If settlement occurs, the depressions should be scarified, filled and rerolled until the surface is solid, uniform and parallel with the grade of the finished pavement. The weight of the roller to be used for compacting subgrades for walks shall be as directed by the engineer.

Centers of Roads and Walks—Centers of roads and walks shall conform in aligment to the center stakes set for them by the engineer.

Material and Construction

Work Required—Work required includes the provision and installation of all materials necessary for the proper completion of the roadways, steps and sidewalks, in accordance with the drawings, this specification, and intent thereof.

Forms—Metal or wooden forms shall be free from warp, and of sufficient strength to resist springing out of shape, and shall be equal in width to the thickness of the pavement at the edges. Wooden forms shall be not less than 2 ins. thick and shall be capped with 2 in. angle irons. Where the roads or sidewalks abut building walls, side forms may be omitted at the discretion of the engineer, but a joint must be constructed between the road or sidewalk and the building wall.

All forms shall be well staked, braced, or otherwise held to the established lines and grade, with the upper edges on a level with the finished work.

All mortar and dirt shall be removed from forms before they are used.

Cross forms for sidewalks shall be either metal or wood, as follows: If of metal they shall be ¼-in. thick and of a depth equal to the full thickness of the slab; if metal cross forms are used the slab may be built to a form on each side and when the concrete has set the metal strip may be removed. If wood cross forms are used, every other slab may be placed and on setting, the cross form shall be removed and other sections placed.

Cinders—Cinders shall be clean, coarse, hard-burned cinders. No soft coal cinders will be allowed.

Materials for Concrete—Materials for concrete shall be in accordance with the latest American Concrete Institute specifications, unless otherwise noted. Fine aggregate and coarse aggregate shall be as specified hereinafter.

Reinforcing for Roadways—Concrete pavements 20 ft. or more in width shall be reinforced. The reinforcement shall have a weight of not less than 28 lbs. per 100 sq. ft. The ratio of effective areas of reinforcing members at right angles to each other may vary from 1:1 to

4:1. The spacing between parallel lines of reinforcing members shall not be more than 8 ins. A reduction of 3 lbs. from the weight specified may be allowed for those types of reinforcement not requiring extra metal at intersections.

Reinforcing metal shall be placed not less than 2 ins. from the finished surface of the pavement. The reinforcing metal shall extend to within 2 ins. of all joints, but shall not cross them. Adjacent widths of fabric shall be lapped not less than 4 ins. when the lap is made perpendicular to the center line of the pavement, and not less than 1 ft. when the lap is made parallel to the center line of the pavement.

The concrete above the reinforcement shall be placed immediately after mixing and in no case shall more than 45 minutes elapse between the time that the concrete below the reinforcement has been mixed and the concrete above the reinforcement is placed.

Reinforcing Rods for Steps—Reinforcing rods for steps shall be of "structural grade." They shall have the sectional area and spacing called for on the approved drawing. All rods shall be cleaned before embedding in concrete.

Integral Curb—The pavements and curbs shall be constructed in one operation, the whole forming an integral unit of the curved batter type, of dimensions as indicated on approved drawings. After the forms are removed, any stone pockets appearing on the surface shall be filled and the curb trowelled over with a wooden float after which a smooth and uniform finish of an approved type shall be secured.

At all points where new curbing abuts existing curbs a neat finish shall be provided. Where new curbs abut roadways without curbs, new curbs shall curve down to an approved radius.

Expansion Joints—Transverse expansion joints for roadways extending through curbs shall be not more than ½-in. thick, and they shall be spaced not more than 30 ft. on centers. All joints shall extend through the entire thickness of the pavement and shall be perpendicular to its surface. Joints shall be provided at changes of grade and at the junction of roadways and sidewalks with buildings.

Sidewalks shall be provided with ½-in. transverse expansion joints, the full depth of the slab, spaced as indicated on approved drawings and in no case more than 50 ft. apart.

All existing curbs, catch basins, manhole tops or other fixed objects which project through the pavement shall be separated from the concrete by joint filler.

Joint Filler—Joint filler shall consist of prepared strips of fiber matrix and bitumen or similar material of approved quality. The bitumen used shall be heated from 225 degrees to 250 degrees F. at the time of application. The joint material swabbed with hot bitumen on top shall extend through the entire thickness of the pavement and it shall be left projecting ¼-in. above the finished surface, before the road is opened for traffic. Care shall be observed in order to prevent the bitumen from speading over the suface of the pavement for a width of more than 1 in. on either side of the joints.

All bitumen used for joints or cracks shall be put on while hot and it shall be covered with clean, sharp sand.

Composition of Concrete—Concrete for roadways shall be mixed in the proportion of 1 part cement, 1½ parts fine aggregate, and 3 parts coarse aggregate. Fine aggregate for roadways shall consist of natural sand or screenings from hard, tough, durable, crushed rock, such as trap, granite, hard limestone or gravel, consisting of quartzite grains or other equally hard material graded from fine to coarse with the coarse particles predominating; when dry it shall pass a screen having 4 meshes per linear inch; not more than 25 per cent. shall pass a sieve having 50 meshes per linear inch, and not more than 5 per cent. shall pass a sieve having 100 meshes per linear inch. It shall not contain vegetable or other deleterious matter, nor more than 3 per cent. by weight of clay or loam. Routine field tests shall be made on fine aggregate as delivered. If there is more than 7 per cent. of clay or loam by volume in one hour's settlement after shaking in an excess of water, the material represented by the sample shall be rejected.

Coarse aggregate shall consist of clean, hard, tough, durable crushed rock or pebbles graded in size, free from vegetable or other deleterious matter and shall contain no soft, flat, or elongated particles. The size of the coarse aggregate shall be such as to pass a 3-inch round opening, and shall range from not less than 1½ ins down. Not more than 5 per cent. shall pass a screen having 4 meshes per linear inch and no intermediate sizes shall be removed.

The cement shall be amply protected from the weather and it shall be delivered for mixing only as required and covers shall be provided for its protection in case of a storm.

Modification of Composition of Concrete—The contractor may have the option to substitute other mixtures of concrete and other sizes for fine and coarse aggregates, providing a 28 days concrete made of such mixture shall have a compressive strength of not less than 3,000 lbs. per one square inch, as ascertained by approved methods, satisfactory to the engineer.

Consistency—Concrete materials shall be mixed for not less than one minute with only sufficient water to produce a concrete which will hold its shape when struck off with a template. The consistency shall be such as not to cause a separation of the mortar from the coarse aggregate in handling. The consistency of the concrete shall be determined by the following test: A cylinder 6 ins. in diameter and ins. in length shall be filled with concrete which shall be tamped until all voids are filled and a slight film of mortar appears on the surface. The cylinder shall then be removed and the vertical settlement or "slump" of the concrete noted. This settlement shall not exceed 2 ins. when a mechanical finishing machine is to be used and shall not exceed 4 ins. when the finishing is to be done by other methods. Materials shall be mixed in a batch mixer, as required in the latest American Concrete Institute specifications as mentioned hereinbefore.

Cross-Section—Cross-section of roadways and sidewalks shall be as called for on the approved drawings. Roadways and sidewalks, when completed, shall be true to the cross-sections, with sides parallel to the center lines and curved at intersections.

Proper superelevation, subject to approval by the engineer, shall be provided at all curves.

Underdraining for Sidewalks—Sidewalks shall be drained by 6 in. porous tile pipes, placed below the cinder fill and leading to catch basins. The porous tile pipes, free from cracks and other defects shall be firmly embedded in the cinders, being covered on the sides, top and bottom with clean gravel or broken stone.

Catch Basins—Catch basins shall be placed where indicated on the approved drawings and elsewhere where found necessary for proper drainage. They shall be constructed of concrete in accordance with approved details and shall be provided with cast iron slotted covers of an approved stock type.

Manholes—Brick manholes of an approved type, provided with iron rings, shall be constructed where indicated on the approved drawings.

Vitrified Tile Piping—Vitrified tile pipes, 6 in. and 8 in. in diameter shall be provided and installed where indicated on the approved drawings and elsewhere where found necessary for proper drainage. Vertical tiles under catch-basins shall be not less than 12 ins. in diameter.

Pipes shall be of single strength with standard sockets. Farm tile may be used if so desired. They shall be thoroughly hard-burned and vitrified inside and out, giving a clear, ringing sound when struck a sharp blow. They shall be free from cracks, checks, blisters, etc., that would impair the strength and durability, and shall be free from obstructions after being laid.

All pipes shall be laid straight and true to an even grade with open joints. They shall be surrounded on the bottom, top and sides with at least 6 ins. of broken stone or gravel, not less than ¾-in. in size and then backfilled with clean, coarse, hard-burned cinders.

Placing of Concrete for Roadways—No concrete shall be deposited in place until the finished surface of subgrade is satisfactory to the engineer. All work incident to the handling and depositing of concrete must be done in such a manner that the surface of the subgrade will not be cut up or depressions made on it.

Immediately prior to placing the concrete, the finished subgrade shall be thoroughly wetted, but there must be no pools of water, and muddy condition will not be allowed.

After mixing, the concrete shall be deposited rapidly upon the subgrade to the required depth in successive batches and in one continuous operation between transverse joints and for full width of roads without the use of intermediate forms between joints.

In case a mixer breaks down the concrete shall be mixed by hand to complete the section. Concrete in excess of that required to complete a section at the stopping of work shall not be used any more in the work.

A transverse joint shall be placed at the point of stopping of the work, satisfactory to the engineer.

The concrete for roadways shall be brought to the required contour from a bridge, no part of which touches the concrete, by means which will insure a compact, dense mass. All holes left on removing any material or device used in construction joints shall be filled immediately with concrete from the latest batch deposited. Special attention shall be given to the concrete at joints to see that it is properly compacted.

Under no condition shall more concrete be laid than can be completely floated before dark.

Finish for Roadways—Two methods of finishing may be used, machine finish and hand finish. In case machine finish is provided, the machine shall be of a type suitable for stiff concrete. In case hand finish is used, as soon as possible after the concrete has been struck off, it shall be rolled with an approved metal roller, having a smooth, even surface, approximately 6 ft. in length, not less than 8 ins. nor more than 12 ins. in diameter, and weighing not more than 100 lbs. On roads less than 20 ft. in width the roller may be operated with a handle which shall be at least 2 ft. longer than the width of the road, and all rolling shall be done from one side of the road. On roads or pavements 20 ft. and more in width the roller shall be provided with two bails, to which ropes shall be attached, and the roller pulled across the road or pavement. The roller shall be operated at such an angle with the center line of the road that it would advance along the road about 2 ft. for each time across. The roller shall pass from one edge of the road to the other, care being taken not to run the roller over the side forms in order to prevent earth or foreign material adhering to it. After the roller has covered a given area in the manner described, the same area shall be similarly covered by the roller for not less than three times at intervals of 15 to 40 minutes, and as many times additional as may be necessary in order to remove any excess water.

After the rolling has been completed the road shall be finished by two applications of a belt made of canvas or rubber belting, not less than 6 ins. wide and not less than 2 ft. longer than the width of the road. The belt shall be applied with a combined crosswise and longitudinal motion. For the first application, vigorous strokes at least 12 ins. long shall be used, and the longitudinal movement of the belt along the road shall be very slight. The second application of the belt shall follow immediately after the water glaze or sheen disappears and the stroke of the belt shall be not more than 4 ins. and the longitudinal movement shall be much greater than for the first belting.

The finished surface of the road shall not vary more than ¼-in. in 5 ft. from that called for on the approved drawing.

Any cracks, either longitudinal or transverse, that may develop before the acceptance of the work, shall be thoroughly cleaned out and filled with an approved bituminous material.

Placing of Concrete for Sidewalks—Sidewalks, consisting of 4-in. one course, concrete blocks mixed in the proportion of 1 part cement, 2½ parts sand and 5 parts stone, not more than 6 ft. square, shall be poured on a thoroughly compacted cinder bed of a thickness as indicated on the approved drawing. The cinder bed shall be thoroughly rammed and wetted before concrete is poured. The ¼-in. wearing surface shall be made integral with the base slab proper as hereinafter specified. Especial care shall be taken in finishing at expansion joints in order to have the surface at both sides of the joints at the same elevation. Under no condition shall more concrete be laid than can be completely floated before dark.

Wearing Surface—Wearing surface for sidewalks shall have a uniform thickness of 1 in. Before the concrete base has attained its initial set, there shall be placed

a wearing course consisting of a stiff mortar composed of 1 part cement, 2 parts of sand, and 1½ parts of crushed granite or stone of equal quality, subject to approval by the engineer, the largest particles of which shall pass through a ½-in. ring and the smallest retained on a ¼-in. screen, free from dust, loam, or earthly substances.

The smoothing up and finishing shall be done from a bridge no part of which touches the surface. After smoothing the wearing surface with a straight edge it shall be floated roughly with a plasterer's trowel, and after a few hours, when the mixture has begun to stiffen, it shall be floated with a wooden float and then with a trowel to a smooth even surface. No application of neat cement or of a mixture of cement and sand will be permitted. After the final floating, the wearing surface shall be grooved and jointed directly above the joints in the base, finishing the joint with a groover.

The sidewalks shall be sloped not less than ¼-in. per foot in order to shed water. The surface of side walks shall be roughened by dotting roller, should the engineer in charge so direct.

Steps—The contractor shall provide reinforced concrete steps where called for on the drawings. All fill shall be thoroughly compacted. The cement mortar finish for treads and risers shall be the same as for the sidewalks. Steps shall have a slight wash, as directed by the engineer, in order to permit water to run off. Reinforcing rods as hereinbefore specified shall be securely held in position while depositing concrete.

Curb Bars and Nosing—Curb bars, nosing or other protective appurtenances of an approved type, shall be provided where indicated on the drawings and elsewhere where necessary to protect exposed corners of curbs or building walls.

Curing and Protection—The concrete work must not be allowed to dry out too rapidly, and must be protected from the heat of the sun's rays by canvas covering. Sprinkling shall also be employed as soon as the concrete is hard enough in order to prevent the surface from being pitted. After the first day an earth covering not less than 2 in. thick should be employed. Such protection for roadways shall be provided for not less than two weeks', the exact time being determined by the engineer. Sidewalks shall be protected by moist canvas, supported above the surface by a suitable frame. Moist sand, or straw may be used in lieu of canvas. Either canvas, sand or straw shall be kept moist for not less than one week. At the expiration of the required time all covering shall be removed and the surface left clean.

The contractor shall erect and maintain suitable barriers in order to protect the concrete from traffic, and any damage to roads and sidewalks due to traffic or other causes or occurring prior to the official acceptance of the work shall be repaired or replaced by the contractor at his own cost and expense, and in a manner satisfactory to the engineer.

Inspection—The work will be conducted under the general direction of the engineer, and will be inspected by the municipal inspectors, who will enforce compliance with the terms of the contract. The inspectors will keep a record of the work done, but the presence of an inspector shall not relieve the contractor or his responsible agent of any responsibility for the proper execution of the work.

Loss or Damage—All loss or damage arising from any unforseen obstruction or difficulties, either natural or artificial, which may be encountered in the prosecution of the work, or from any action of the elements, or from any act or omission not authorized by this specification on the part of the contractor or any agent or person employed by him, shall be sustained by the contractor at his own cost and expense.

City Property—All material of value to the city removed by the contractor from present positions, shall remain the property of the city and shall be deposited by the contractor within 500 ft. where directed by the engineer.

Damage to City Property—The contractor shall take such precautions as may become necessary in order to prevent defacement or other injury to buildings and other city property. The contractor shall at all times protect all trees and shrubbery in the vicinity of the work under this contract and shall in no case remove any trees or shrubbery without the consent of the engineer. Any and all damages to city property resulting from neglect or carelessness by the contractor or his employees will be charged to him or shall be made good by him at his own cost and expense to the full satisfaction of the engineer.

Cleaning—After the protective coating is removed, the roadways shall be thoroughly cleaned before opening for traffic, and the protective material disposed of at points within 500 ft. of the place of removal, as directed by the engineer.

GOOD ROADS DECREASE COST OF LIVING

How much more vigorously would the newspapers of the country prosecute the nation-wide campaign for improved roads if they realized how inextricably good highways are linked up with the supply of newsprint paper!

When the misuse of our extensive forest lands began to approach the point of profligacy, the editors of the United States—one and all—shouted lustily, and with great effect, until Congress passed legislation to preserve the forests and thereby conserve the supply of wood pulp, without which paper cannot be manufactured. Now the publishers are experiencing a shortage of paper, and aside from the old cause, that the demand is greater than the

TEXACO ASPHALTIC CONCRETE LAID BY THE MURRAY CONSTRUCTION CO., ON SHERARD ROAD, COAHOMAS COUNTY, MISS. THIS VIEWS SHOWS THE VARIETY OF TRAFFIC THIS HIGHWAY CARRIES.

supply, one of the causes for the shortage and high costs is the difficulty and expense of transportation!

The problem is not that of educating the road building and engineering professions of the country to the necessity for good roads. But the problem is to educate the laymen and general public to the all-important bearing which improved highways has on the cost of living. As in the production of newsprint paper, so in the production and transportation of food-stuffs, fuel, lumber, and other commodities, modern highways play a role of inestimable importance.

Much time and effort has been spent in the advocacy of modern highways for main trunk lines joining centers of commerce and business. Of only slightly less importance, however, is the question of paving the principal side roads over which products must be transported to the main trunk highways.

Wood coming from the forests must first pass over the side roads before reaching the main highways; foodstuffs from the farms usually must be transported over roads other than the principal highways before reaching the cities. So one of the main problems which the road building profession faces today is the erection of suitable, durable, and high-type side roads. The reduction in the cost of haulage, the rapid transportation which saves food-stuffs from deterioration, and numerous other benefits more than pay for the cost of building the modern highways.

Nearly every State in the Union has "seen the light," and the counties and townships have begun to build durable roads. The State of Arkansas plans to build 629 miles of asphaltic concrete roads, and 660 miles of bituminous penetration work, in addition to considerable mileage of the temporary type. As an example of what counties are doing, Burlington County, New Jersey, will build this season 20 miles of modern sheet asphalt pavement, which will, added to the construction of last year, take care of the county's immense agricultural traffic between New York City and Philadelphia.

An impression of the value of modern pavements on the side roads of the country may be gained from the accompanying photograph of a road in Coahoma County, Mississippi. This picture shows the variety of traffic which the road carries, including everything from light and heavy motor truck traffic to the tremendously heavy iron-wheeled traffic of the mule-drawn lumber wagons.

AMERICAN ASSOCIATION OF ENGINEERS PASSES 20,000 MEMBERSHIP MARK.

The American Association of Engineers passed the 20,000 membership mark on July 27, 1920. The Association for some time has been the largest organization of engineers in the world, but attainment of this great number of members is of great significance in marking the continuation of the most rapid growth which has ever characterized an engineering society.

The association was organized in 1915—five years ago. At the beginning of 1919 it had about 2,300 members. At the beginning of 1920 it had 10,450 members. The growth in 1919 was 8,150 members; that in the first seven months of 1920 was 9,550. In other words, the association is growing about twice as fast this year as in 1919.

Since the first of the year 1919, the number of local chapters and clubs of the association has increased from 26 to 209. The national characteristics of the organization are fully borne out by the distribution of these local groups in almost every state in the union.

The American Association of Engineers has enlarged its national headquarters in Chicago from about 2,000 sq. ft. of floor space to over 6,000. It now occupies the entire sixth floor at 63 East Adams Street. District offices are maintained in New York, Washington, D. C., Pittsburgh, San Francisco and El Paso, Texas. A number of chapters in other cities also have paid employes and maintain offices.

The employment service of the association now fills an average of 300 positions a month, ranging in salary from $1,500 to $15,000 a year.

The official publication, Professional Engineer, established in January, 1919, has been received by the profession with enthusiasm and has a total circulation of 26,000.

In addition to National Secretary C. E. Drayer and about sixty assistants, the working force has recently been augmented by the appointment as director of field forces of Dr. Frederick Haynes Newell, formerly director of the U. S. Reclamation Service. Dr. Newell, who is head of the department of civil engineering in the University of Illinois, is in general charge of the development of existing chapters and clubs.

A feature of the growth this year is the establishment of state assemblies in several states. These are state organizations made up of the A. A. E. chapters and clubs in the state. Such assemblies are formed or in the process of formation in Ohio, Nebraska, Washington, Michigan, North Carolina, Wisconsin, California, Pennsylvania and Montana. The Michigan Assembly is built around the Michigan Engineering Society, which affiliated with A. A. E. last spring. Other societies to affiliate within the last year or so are the Southwestern Society of Engineers, now the Southwestern District of A. A. E., Oregon Society of Engineers, Engineers' and Architects' Association of Southern California, North Carolina Society of Civil Engineers, Northwestern Association of Highway Engineers, Idaho Society of Engineers, Engineers' Club of Kansas City, and others. As an example of growth of local societies following such affiliation the Southwestern Society has grown from 200 members to about 1,000 members.

ADVANTAGES OF THE GREAT LAKES-ST. LAWRENCE WATERWAY

By Edmund T. Perkins, V. P. Mississippi Valley Association, Consulting Engineer, 1211 First National Bank Bldg., Chicago, Ill.

Advocacy of the Great Lakes-St. Lawrence Waterway to the sea does not argue opposition to the Great Lakes to the Gulf Waterway but indicates an intelligent appreciation of the strategic situation and the necessity of all channels to the sea being developed and utilized to the

utmost. It should not be forgotten that partisan development dividing the United States into "the North" and "the South," aided greatly in making the great trunk railways develop east and west through the northern part of the United States with heavy grades into the troughs of the valleys and out again over the divides with wasteful and expensive operation, rather than all down hill across the Mason and Dixon Line to the ports of the Gulf of Mexico and the southeast Atlantic. Always partisan and provincial, some great little men of New York fear the development of the great Mississippi Valley and the West, unless under their wise control and for their personal profit. One of these opponents of the St. Lawrence project raises the alarm the soil of the west is exhausted. If this is true, why are the deserted and idle farms only in New York and the New England states? Should not these same vacant farms open the eyes of Easterners to the need of the development of every possible horse power of hydro-electric power along the St. Lawrence that manufacturing may restore to their states the prosperity that exhausted agriculture has taken from it?

The West and the Mississippi Valley must have its ways to the seven seas unhampered by the specious arguments of special pleaders.

The development of the interior of the United States, especially of the Mississippi Valley, is a matter of such magnitude that no individual should dare raise opposition. A liberal mind should realize the increase in national wealth means the increase in individual wealth. The opening of both the proposed waterways through the Great Lakes and the St. Lawrence to the sea and through the Ohio, the Illinois, the Missouri and the Mississippi Rivers to the Gulf of Mexico means just as much to New York and the east and to the gulf countries as it does to the states about the Great Lakes and directly west therefrom, and *fortunately most of the business men of New York and the East realize this.*

Today, undeveloped as it is, the Mississippi Valley is the center of production of every staple product of the soil that supports life and is the initial wealth producer. It is the center of production of cattle, hogs, sheep, horses, mules and the great American hen, one of the largest sources of wealth, and its products now are blocking all the transportation efforts of the railroads to the East and of the ports to which these roads lead. In a few years, a generation or two, with our desert lands irrigated, our swamp lands reclaimed, our hydro-electric power developed, our mines in full operation, there will be such a volume of production and traffic that all the railways, all the waterways and all the roadways will but illy serve to give relief. Cannot the doubting Thomases recall the Louisiana Purchase, Benton and the Great American Desert, the Alaska Purchase and all the other great adventures of the United States that were going to bring ruin and have only brought wealth and prosperity?

ADDENDUM

Centers of Production

"The Mississippi Valley has a present productivity in terms of percentage of the total:

Corn Production	65%	Flax Production	
Wheat Production	74%		Practically 100%
Cattle over	50%	Wool	47%
Hogs	57%	Coal mined	36%
Horses	60%	Coal Reserves	72%
Butter	54%	Copper	39%
Eggs	54%	Lead	46%
Cheese	57%	Iron Ore	85%
Apples	21%	Zinc	74%
Beet Sugar	53%		

"The course of the St. Lawrence is from the heart of the North American continent directly toward the principal part of Europe"—H. C. Gardner.

Undeveloped Resources

"The western and northwestern states have under cultivation from less than one-tenth to more than three-fourths of their tillable land. Yet the number of farms is increasing very slowly in some states or has been stationary for years in others. These and other figures show that they have reached or are approaching a condition of saturation under existing conditions.

"In Minnesota, for example, one-sixth of the land is under cultivation. If, 30 years from now, Minnesota makes a contribution to the other states of food supplies in proportion to its present surplus, there will be more than 35 per cent of its land under the plow. In varying proportions the same is true of the other states. This is the surplus food producing area of the United States. The population is increasing, the demand for food is increasing. The time has long passed when there can be any substantial increase in acreage in New England, the Middle States and some other areas. The increase must come in large part from the states of the lake territory. The resources are available; the increase in production to correspond cannot be read from past or present tendencies. The change in conditions must come by other means than a mere expectation of additional acreage. There is no such increase in sight under existing conditions."—Chas. P. Craig.

Transportation Shortage

"A. H. Groverman, representing the coal industries, declared at Superior that there was no coal shortage, and had been none in years, due to inability to furnish coal at the mouth of the mine. The mines can raise coal as fast as they can load cars; continuous operation is dependent on car supply. If this lakes-to-ocean route were open today,' he declared, 'the railroads could strike off one billion dollars from their estimates of needed equipment.'

"F. W. Holdredge, general manager of the Burlington, declared at Omaha that if the Burlington could deliver its tonnage at the Chicago terminal, it would double the carrying capacity of its present equipment."—Chas. P. Craig.

Manufacturing Supremacy

"Where are the engines?

"Seventy per cent of stationary prime movers are east of the Mississippi.

"Where is the power?

"Seventy per cent of the fuel reserve and water power are west of the Mississippi.

"What is the situation?

"The east is daily on the edge of a fuel famine.

"What of the future?

"The east is daily eating into its power reserves."—Robt. R. Dunn.

New York the Chief Beneficiary

"Recurring again to the power possibilities of the St. Lawrence, I venture to say that it is readily perceptible to anyone that of all the states bordering or tributary to this waterway the greatest beneficiary of the development will be the great Empire State of New York. The letting loose of this flood of power over her territory will cause her to leap to the front as a manufacturing state, and her products so stimulated by cheap power will find market in all the countries of the world. With her magnificent harbor and the superb advantage of her barge canal affording cheap water transportation thereto, and at the same time enjoying and possessing all the benefits of the St. Lawrence route, hundreds of miles nearer salt water than her western competitors, her high-value manufactures will have a permanent primacy over any other state of the Union. Indeed, it is no idle dream to picture her barge canal and her lake shore dotted with factories of all kinds in enjoyment of this 'white coal' at low rates in operation 365 days in the year, independent of season, their power coming into the factory on a wire instead of by rail and upon cars, free from labor, climatic, or transportation trouble or interruption. No other state of our Union has the same strategic advantage in power, population, labor supply, and transportation, and these advantages for natural and geographical reasons can probably never be lost; and this notwithstanding that the day is coming when the West will hold most of the black-coal reserves of the country in addition to her everlasting majority of the 'white-coal' supply."—Alexander T. Vogelsang, First Assistant Secretary of the Interior.

SOME POINTS TO OBSERVE IN DESIGN OF SEWERAGE SYSTEMS AND DISPOSAL WORKS

By Theodore Horton, Chief Engineer, New York State Department of Health, Albany, N. Y.

(Editor's Note:—The following paragraphs are from a discussion on this subject before a conference of City Engineers of New York State held recently at Jamestown, N. Y. Mr. Horton points out some features to be kept generally in mind by the city engineers of the State.)

Separate Systems for Sewage and Storm Water.

Sewerage systems of many of the older cities have unfortunately been constructed on the combined plan. I say unfortunately for several of these old cities are situated on smaller streams or bodies of water where combined systems are not appropriate and as a result have, in recent years, reached an embarrassing point where provision for future extensions and for interception and sewage treatment will be attended with greater expense and where future conditions resulting from storm water overflows will become more insanitary. My advice therefore in regard to all cities except perhaps a few situated along our larger rivers, lakes and tidal waters, is:

(1) To adopt the separate system as soon as possible and so far as practicable, since it will be more economical in the end with respect to both collection and disposal.

(2) In those cities situated on larger rivers where combined sewers have been built and are still in operation, and where extensions of them are permitted by the State, to see that no combined sewers are built in any outlying section which would now, or in the future, involve overflow into any small tributary of the main river.

(3) To design all sewers and sewer outlets, either separate or combined, so that they may be properly intercepted in the future by main intercepting or outfall sewers that may be carried to properly located sewage disposal works.

Capacities, Sizes and Grades of Sewers

In the design of sewers a simple and safe rule that may be followed is to allow approximately 300 gals. per capita for the population to be served, designing lateral sewers to run one-half full, and intercepting and outfall sewers to run full. These rates will generally take care of daily and seasonal fluctuation in rate of flow of sewage; and, if minimum grades are carefully observed which will provide ordinarily velocities equal to 2.0 ft. per second, and in no case less than 1.5 ft. per second, running full or one-half full, little difficulty will be experienced in operation or maintenance.

Manhole, Flush Tank and Siphons

The use of manholes along sewers is generally conceded absolutely necessary whereas the use of flush tanks is largely optional. Manholes should be spaced at intervals of about 300 ft. and never over 400 ft. apart except on large sewers. Manholes should also always be placed at points of changes of grade and alignment. Where slopes are very steep, drop manholes are advisable.

The use of flush tanks at the head of all sewers laid on minimum grades should be considered compulsory. Elsewhere their use is optional, keeping in mind, however, that where not installed, flushing by hand should be done occasionally and at least once yearly.

Inverted siphons should ordinarily be avoided but should not entirely be shunned. Their design is very important and better practice sanctions at least two lines of siphon pipe. I would suggest also that the cross section of all channels of flow, especially the head houses, be restricted in area in order to keep the velocities well maintained and the channels free from accumulations of sludge and grease.

Sewage Disposal Works

This subject is obviously too broad to cover by a discussion. As already pointed out, also, it would be impracticable to lay down hard and fast rules since each case must be considered an individual one and be determined in the light of local conditions and requirements. While ideas on the subject have changed very considerably in recent years, opinions among experts today are, however, quite agreed upon many essential points. Many engineers at the present time seem to overlook the essential fact that sewage disposal works are not designed primarily for the purpose of keeping streams pure for drinking purposes, but more to keep them in a sufficiently clean condition to prevent a nuisance. In fact it is only rarely that disposal works are designed to protect water supplies and even then it is usually to prevent any undue burden upon a water purification plant that may be situated below on the stream.

The requirements to be made in any case are not a simple matter and require careful study and fine judgment. Generally speaking, the policy of our Department

is at present to demand only such degree of purification as will meet the fundamental requirements already stated. In fact while I have frequently shocked applicants for approval of sewage disposal plans by demanding a higher purification than they have endeavored to get away with, I have on the other hand occasionally shocked one by frankly telling him that the degree of purification sought was unnecessarily high and wasteful. In brief, protection of health and freedom from nuisance must obviously be the appropriate end sought, and the aim of our Engineering Division is to see that this principal is observed but not abused; and with this end in view I feel sure we have the support of all.

Concerning sewage disposal design I feel quite convinced that simple, positive and reliable methods of treatment are preferable to those methods which are yet in an experimental stage or which have not been proven efficacious in practice or economical and simple in operation. I do not mean by this that I endorse the old-fashioned flat bottom settling tanks, not even septic tanks, in view of better and more effective types; but I do mean to warn against the installation of expensive and elaborate types until these systems shall have proven their efficacy and reliability through wide applications and experience.

At the present time sewage screens seem destined to play a more important part in sewage disposal than formerly and improvements in design and mechanism are rapidly increasing. Tanks of the two-story type, or of the plainer Hopper bottom type, have proven both effective and economical and, properly designed, eminently suitable for preliminary treatment. Contact beds though still applicable to some local conditions, seems not to be as efficient or adaptable as sprinkling filters. Sand filters still hold, and probably will continue to hold, the highest place in sewage treatment where a high degree of purification is demanded. Activated sludge treatment while concededly practicable, seems still to have inherent features which are difficult to control and much hesitancy still exists among experts in recommending this treatment except under special conditions. Sewage disinfection, while offering a limited field of application, is an invaluable method of treatment where bacterial purity is required; and may often be advantageously used in combination with tank treatment alone or as a final and finishing process to filtration where water supplies, shellfish or bathing beaches are to be protected.

One feature in regard to this subject which I particularly desire to stress is regarding maintenance. I refer not so much to the sewers as to the disposal works which in most cases have been constructed at considerable cost and the benefits from which, in many instances, have been largely nullified by careless operation and in some cases absolute neglect. If these disposal works are worth building at all they are certainly worth operating and if civic pride and sound business policy is not sufficient incentive to induce proper operation of these works when once built, I am sure that the State Departments of Health and Conservation are justified in taking suitable action to force it. In this attitude I feel that we should have the support of city engineers for after all, the question is one that affects every municipality in the state either directly or indirectly, and the views and opinions of city engineers, carry more weight in matters of this kind, than those of other persons or officials in the community.

CO-OPERATION BETWEEN ENGINEERING SOCIETIES AND EDUCATORS IN STANDARDIZING ENGINEERING EDUCATION.

By J. H. Dunlap, Associate Professor of Hydraulics and Sanitary Engineering, College of Applied Science, State University of Iowa, Iowa City, Iowa

(Editor's Note:—In his paper before the recent annual convention of the Society for the Promotion of Engineering Education, Professor Dunlap presented a strong case for the broad standardization of engineering education through co-operation between engineering societies and educators. Going back about 20 years, he pointed out that in the academic year 1898-99 only 14 per cent. of the medical schools required for admission more than a one-year high school course, as compared with 33 per cent. of the law schools and 80 per cent of the engineering schools. Moreover, 91 per cent of the medical schools had a four-year course with an average of 28 months in attendance, as compared with 98 per cent. of the engineering schools with an average of 35 months in attendance. The law school course was much briefer than that of either of the others. Accordingly, 20 years ago the requirements for admission to engineering schools as well as the length of course greatly exceeded those of the law and medical schools. The same tests applied at the present time show changes decidedly unfavorable to the engineering schools, as the following extracts from his paper show conclusively.)

The medical schools, 20 years ago at the bottom, are now at the top; while the engineering schools, 20 years ago at the top, are now at the bottom, with the law schools in a middle position. Furthermore, the leading dental colleges will require in 1921 one year of liberal arts college credit for entrance to the four-year dental course. Moreover, the graduation requirements of the leading schools of theology now consist of a four-year liberal arts course, plus a three-year theological course. Accordingly the engineering colleges, requiring four years of study in addition to a four-year high school course, are now fifth on the list of professional colleges. Indeed it is very doubtful if they should be classed as professional colleges at all. There is certainly much justice in classifying technological schools in the reports of the United States Bureau of Education with universities and colleges, while schools of medicine, law, dentistry, theology, pharmacy and veterinary medicine are classed together as professional schools.

Advances Made by Other Professions

These advances have not been brought to pass by the medical, legal and dental professions without great effort. After years of work the Council on Medical Education of the American Medical Association has prescribed standards by which medical schools are now classified into A, B and C classes. The State Medical Examining Boards have co-operated voluntarily, by deciding that they would accept only graduates from recognized schools. As a result of this policy, there are now 85 recognized medical schools, 78 of which require two years or more of work

in the liberal arts college for entrance to the medical course. Furthermore, eight schools are now requiring, in addition to two years' work in a liberal arts college, and a four-year medical course, a seventh year as interne before granting the degree of M. D. In addition to the standardization of medical schools, a model curriculum has been prepared.

In the case of law schools, rapid development is now taking place. Among the 50 law schools holding membership in the Association of American Law Schools, about 20 now require two years or more of liberal arts work for entrance to the law course of three years or more. The American Bar Association is at work on the problem of standardization of law schools. It is expected that the meeting of the Association at St. Louis this summer will initiate a plan which will accomplish this end.

It is interesting to note that the curricula of the law schools have followed so closely the leadership of the law schools at Harvard and Columbia that there is no need for a model curriculum.

In the case of the dental colleges, the Dental Faculties' Association of American Universities and the Dental Educational Council have been engaged for some time upon the problem of standardization of dental schools. In 1921 the dental colleges holding membership in the Dental Faculties' Association of American Universities will require one year of liberal arts work for entrance to the four-year dental course. It is expected that this requirement will be raised later to two years' liberal arts and four years' dental work. The final step is expected to be a seven-year course with combined work in the liberal arts college, the medical college, and the dental college.

Certain immediate effects of the higher graduation requirements of the medical, legal and dental schools are obvious. In the first place, the more thoughtful and resourceful students, other things being equal, will be attracted to these professions by the fact that they are apparently of higher grade than the engineering profession. In the second place, the students who come to a university as they would come to a trade school, with the purpose of finding the shortest cut to a fairly respectable job that will provide them a living, will be attracted to the engineering profession. In addition to these immediate effects, it is not difficult to forecast something of the ultimate result of the competition for leadership in a given community between graduates who have been broadly and thoroughly trained in the medical, legal and dental schools, and graduates who have been narrowly and superficially trained in the engineering schools. We will all agree that engineering schools should be, and are, consecrated to the task of fashioning a human product which shall lead our communities into ways of keen analysis of their problems, and the economic execution of every kind of project. But without the broadest and most thorough training, will such leadership be gained by the engineering profession?

A clear statement of the issues involved is contained in the following statement by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York City:

> The head of a large industrial corporation, who was also the chairman of a board of trustees of an engineering school and was urging the broadening of engineering education, put the case in this way: "We can get plenty of men who are technically competent, who are careful and thorough in their investigations, whose conclusions we know to be sound, but who cannot make a favorable impression before a board of directors. We can get plenty of lawyers who, after being coached by our engineers, can glibly and even convincingly talk to the same board of directors until some question is asked which has not been covered in the process of coaching, when they too will flounder about. If we can secure a man who possesses the conscientious thoroughness and accuracy of the engineer, and also has the facility of expression and persuasiveness of the lawyer, what is a salary of $25,000 or of $30,000 for such a man?"
>
> He therefore urged that this particular school, instead of trying to turn out a large number of $2,000 to $5,000 men, give to the profession a limited number of $25,000 to $30,000 men.

In this connection one cannot help inquiring to what extent the prevailing complaint against underpay by the engineering profession, both practitioners and teachers, is due solely to the faults of the individuals themselves in not possessing the qualities of leadership which are always held at a high premium.

Factors in Standardization of Engineering Schools

With engineering schools at the bottom of the list so far as requirements for graduation are concerned, it would seem that it is high time for the development of a comprehensive plan for the standardization of engineering schools and of their curricula. The following factors are suggested as of possible importance in such a plan for standardization. The factors are based to a large extent upon the present schedule for grading medical schools.

1. Length of curriculum including requirements for entrance, etc.
2. Character of curriculum, grading of courses, sequence of subjects, supervision, administration, etc.
3. Engineering school buildings, adaptability, heat, ventilation, cleanliness, etc.
4. Laboratory facilities.
5. Co-operation with the industries.
6. Student organization and extra-curriculum activities.
7. Full-time instructors and assistants with special references to their qualifications and evidences of their work including research.
8. Faculty, number, qualifications and organization.
9. Library, museum, charts and special apparatus, and evidences of the use made of them.
10. Showing of graduates at state board and other examinations, and other evidences by which the training received is indicated.

Of course the preparation of a model curriculum would be one step in the process of standardization.

Objections to Standardization of Engineering Schools and Curricula

Objections to any proposition for standardization of engineering schools and curricula may be expected. When the combined liberal arts and medical course was proposed, such a plan was pronounced by one disting-

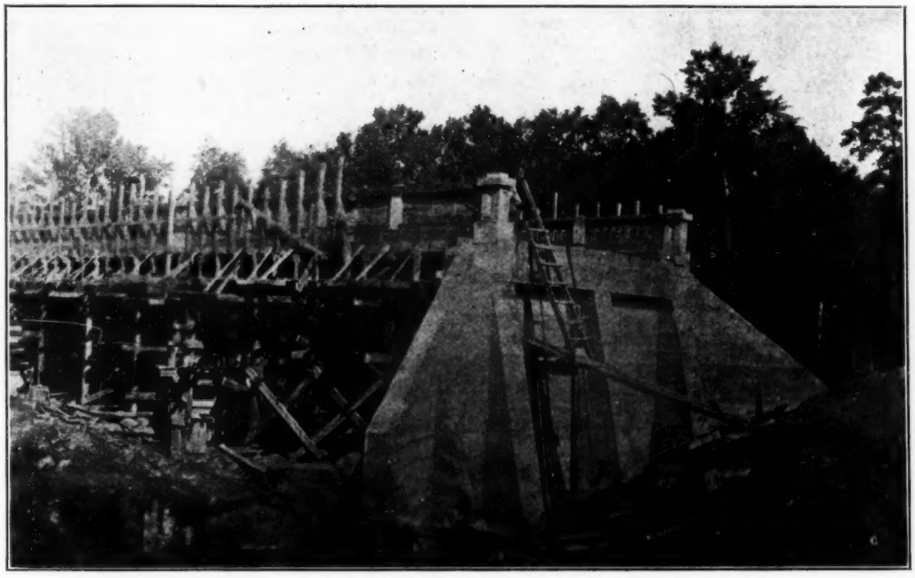
uished educator to be pernicious; by another, "to be a very dangerous process, that indeed there is no more alarming process now going on in the United States in regard to education than this." Associations of College presidents protested against it, and resolutions to prohibit the practice were considered by the board of regents of the University of the State of New York. The lengthened course was declared to work a hardship upon the poor boy who wants to get an education. The unanswerable question was propounded, "Who will practice at the country crossroads and the backwoods districts if a thorough medical training is insisted on?"

Two possible objections to the project under consideration may be briefly discussed. In the first place, it may be objected that standardization will mean stagnation in engineering education rather than progress. The practical answer to such an objection is the experience of the medical schools of the United States. Standardization in the sense that all institutions would be in the same lock-step is not intended. For instance, it is said that no medical school in the country conforms to the model curriculum prepared by the American Medical Association, and yet every medical school is profoundly grateful that such a model curriculum has been prepared. By such standardization as is contemplated, sufficient elasticity would be provided so that the individualities of the various schools would not be unnecessarily interfered with. By frequent revision of the standards, progress made in any direction anywhere would become quickly available everywhere. The individuality of different teachers would be reflected in the different content and length of the several parts of the curriculum of any institution.

A second objection, more real than the first, is that additional requirements for graduation will decrease the number of graduates, and that at the present time there is a great under-supply of engineers. If there is at the present time an under-supply of engineers, the advertisements for positions wanted in engineering periodicals and the activities of the employment agencies seeking employment for engineers give an erroneous impression. Such increases as have been made in the requirements in the past have not had the effect of greatly curtailing the number of engineers. The law of supply and demand has worked very well in the past and may be expected to in the future. At times there will be a scarcity of engineers, and at other times as we all know, there will be a great surplus.

The Next Step

President Hollis, in his address before this Society last year, on "Engineering Colleges and Administration," gave as one of his conclusions, "that the national engineering societies should be asked to co-operate not only with this association, but with the colleges themselves toward broadening out engineering education." In harmony with this suggestion and with the facts stated in this discussion, it is believed that this society should appoint a committee on curricula of engineering schools to co-operate with the existing committee on curricula of engineering schools of Engineering Council, the membership of which consists of Alexander C. Humphreys, Chairman, D. S. Jacobus, Edwin Ludlow and Comfort A. Adams. By the co-operation of these committees, a plan could be devised to bring about such a degree of standardization as will fit the present situation, and will prepare for future developments in further co-operation and standardization.



CONSTRUCTION VIEW OF WEST ABUTMENT AND PART OF CONCRETE STRUCTURE, FLINT RIVER BRIDGE.

THE FLINT RIVER BRIDGE, MACON COUNTY, GEORGIA.

By W. R. Neel, State Highway Engineer, Walton Bldg., Atlanta, Ga.

One of the largest and most satisfactory highway improvement projects in the state of Georgia is known as Federal Aid Project No. 7, in Macon County. It has a

VIEW OF CONCRETE APPROACH TO FLINT RIVER BRIDGE, MACON COUNTY, GEORGIA.

total length of 4,700 ft., and 1,540 ft. consists of a concrete approach to a steel bridge of three riveted truss spans of 120 ft. each, making a total bridge length of 1,900 ft. The total cost of the completed project is $169,467.

This structure crosses the Flint River, near Montezuma, Georgia, in what is known as the peach belt. It has been under construction for slightly over a year. A view of the west abutment and a part of the concrete structure is shown herewith. There is also shown a close view of the approach of the structure, and a side view of the new structure, in which the old bridge structure can be very clearly seen. The difference between the old and new structures will be noted with interest.

The project, as stated, consists of bridges and approaches connecting Montezuma and Oglethorpe. The Flint River, like others in this vicinity, rises rapidly during rainy seasons. During the period of high water it floods large portions of the surrounding country and then gradually subsides.

The concrete viaduct consists of two-column bents supported on wooden piles. The deck consists of five girders of 35-ft. span, supporting a 9½-in. concrete deck, which is covered with a surfacing of Kentucky Rock Asphalt, 2 ins. thick and 17½ ft. wide. The spindles and rail of the railing are of pre-cast concrete construction. In the railing ⅝ in. expansion joints were placed at every other span. Some cracks developed in this hand-rail because the expansion joints were not kept in the same plane.

No other difficulties of importance were encountered in the work and it is believed the structure will be a permanent monument to the zeal and efficiency of the engineers and contractors involved. This was the first structure of any magnitude completed under the new regime now prevailing in highway affairs in Georgia. The work was characterized throughout by a spirit of co-operation on the part of all concerned, which promises much in the way of substantial, permanent crossings to carry modern traffic across the many streams of the state which now make some parts of it inaccessible at certain periods of the year.

The plans for this structure were prepared by Garrett & Slack of Montgomery, Alabama, under contract with the State Highway Department. The project agreement with the Bureau of Agriculture was executed August 4, 1918, and modified Oct. 6, 1919, by which the state secured Federal Aid to the amount of nearly $85,000.

The contract for 3 riveted steel spans of 120 ft. each, with accompanying pier-work, was let to Austin Brothers Bridge Co., of Atlanta. The concrete work of 1,540 lin. ft. of reinforced concrete bents, deck and railing was awarded to the Nichols Contracting Co. of Atlanta. The Nichols Contracting Co. also had the contract for making the earth fill of approximately 54,000 cu. yds.

ASPHALT WORK IN PROVIDENCE, R. I.

By M. M. Cranston, New England Division, Asphalt Sales Department, The Texas Co.

The Board of Public Works of Providence, Rhode Island, has begun work on this season's paving program. The sheet asphalt work is being done by the Narragansett Improvement Company, and in addition to this there will be approximately 90,000 sq. yards of asphalt penetration work.

Most of the sheet asphalt will be laid on a 6-inch cement concrete base, using a 1½ inch binder and a 1½ inch top. It has been found here that on certain streets a 6-inch compressed gravel base makes a stable and satisfactory foundation, and therefore some of the sheet asphalt will be constructed on this type of base. Where it is necessary to repair the older sheet asphalt construction that has undergone years of heavy traffic, a crushed stone base penetrated with asphalt will be used.

The penetration work to be done will consist for the most part of about 3 ins. of clean crushed stone applied

VIEW OF THE THREE STEEL SPANS OF THE FLINT RIVER BRIDGE, MACON COUNTY, GEORGIA. THE OLD BRIDGE STRUCTURE CAN BE CLEARLY SEEN.

Waterbound macadam road looking north from village of Saugatuck, Michigan, treated with "Tarvia-B" in 1917, 1918 and 1919.

West Michigan Pike, near village of Douglas, Mich. Waterbound macadam treated with "Tarvia-B" in 1917, 1918 and 1919.

In oval: Waterbound macadam road near South Haven, Mich., patched with "Tarvia-KP" and treated with "Tarvia-B" 1918, 1919.

West Michigan Pike, Van Buren County, Michigan. Waterbound macadam roadway treated with "Tarvia-B" in 1918 and 1919. Part of a 15 mile stretch of Tarviated roadway.

Tarvia will save the country's roads—

ALL over the United States there are thousands of road commissioners facing the prospect of having to build new roads at the present high cost of construction.

And all around them are miles and miles of old gravel and macadam roads, not in themselves equal to traffic conditions, but which can be made serviceable if they are repaired and given a Tarvia treatment.

Some Michigan roads, illustrated herewith, show how easily and economically old roads can be salvaged with Tarvia.

One road, for instance, was so bad that the Township Board decided the only thing to be done was to rebuild it at the cost of a new road, but after seeing results obtained on other roads, decided to patch and treat with "Tarvia-B" and stone chips, and—"*the road is better than when new*," they say.

It is just as easy for your community to beat the high cost of new roads by saving and restoring your old ones. It is almost a crime to neglect your old roads and let them go from bad to worse, when Tarvia treatment can be applied so easily and cheaply.

Tarvia is a coal-tar preparation for restoring old roads and building new ones. With it you can also widen your narrow roads by adding Tarvia macadam shoulders. It provides a smooth, dustless, mudless, waterproof, traffic-and-frost-proof roadway at moderate first cost and with the minimum upkeep expense.

"Tarvia-KP" is a cold treatment for patching existing roads of every type. It fills up worn places, restores broken shoulders and edges and keeps the road always at the top notch of condition.

Let our engineers advise you how to salvage your old roads with Tarvia, at very attractive costs.

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Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

New York, Cincinnati, Minneapolis, Atlanta, Lebanon, Chicago, Pittsburgh, Dallas, Duluth, Youngstown, Philadelphia, Detroit, Nashville, Salt Lake City, Milwaukee, The Barrett Company, Boston, New Orleans, Syracuse, Bangor, Elizabeth, St Louis, Birmingham, Seattle, Washington, Buffalo, Cleveland, Kansas City, Peoria, Johnstown, Baltimore

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to the existing foundation, and then this will receive an asphalt penetration treatment, which has been giving uniformly satisfactory results in Providence during past years.

ONE-MAN CONTROL SPEEDS IDAHO ROAD BUILDING

The greatest development in Idaho's road building program has come since the work was placed under the complete control of one man, the Commissioner of Public Works. Since his appointment in April, 1919, three times as much work has been accomplished as was done by the State Highway Commissions in the six years of their existence, says the Idaho Highway Bulletin for July 15, 1920.

When the State Highway Department was organized in 1913, the work was placed under the direction of three commissioners, living in widely separated parts of the state. Later on the personnel of the commission was changed, but there were still three members, and important business had to wait until the commission could get together. In many instances considerable time was lost before a meeting could be held to decide on questions of policy.

In the early years of the Highway Department, all work was paid for by the state and counties or highway districts. The Federal Aid Act was passed in 1916, but did not become effective in any state until the legislature passed a cooperating act. Idaho did this in 1917, and in 1918 a small amount of work was done in Custer County. However, it was not until the Spring of 1919 that the full road program of the state was well under way.

Governor Davis, recognizing the difficulty of handling the work effectively with three directors, abolished the State Highway Commission and placed the entire administration of the department in the hands of a Commissioner of Public Works, who was held strictly accountable for the efficiency of the Bureau of Highways. Politics were barred absolutely from the department, and a first class organization has been built up to handle the road program of 1919 and 1920.

Under the State Highway Commission it would have been impossible to carry out this large volume of work without vexatious delays, and frequently without serious financial loss to the state. With one man in direct charge, empowered to act instantly on any proposition brought before him, these delays have been eliminated.

The program for 1921 and 1922 will overshadow the work of the past biennium, both in magnitude and in its importance to the people of the state. It is absolutely essential that the present system of administration be continued, in order that this construction may be handled promptly and efficiently. No three men, no matter how able each may be, can carry on the work as effectively as one man who can keep in close touch with the details at all times.

When the Department of Public Works was created by Governor Davis, The Bureau of Highways was a very small organization. The War had made highway construction next to impossible, but the boys came home in 1918 and conditions seemed to be getting back to a normal basis early in 1919. It was necessary to build up a large engineering organization to handle the proposed road program. During 1919 much of the time was spent on necessary preliminary work, making surveys, preparing plans and estimates, and getting ready for a great deal of construction in the latter part of 1919 and in 1920. The large amount of work now under construction vindicates the wisdom of the careful preparations made during 1919.

CONCRETE FORDS GIVE SATISFACTION IN IOWA

Winneshiek county, Iowa, in meeting a difficult bridge situation will experiment with a concrete ford instead of the ordinary bridge structure. The site is on a township road little used and in bad condition, yet it is necessary that some sort of crossing be provided at the location. The drainage area is about 5000 acres of very hilly land. The run-off following rain storms is extremely rapid, making it necessary in case a bridge of the ordinary type were built to provide a very large waterway.

Upon the suggestion of District Engineer, J. W. Mercer, of the Highway Commission, County Engineer Arneson, plans to build a concrete ford providing a waterway beneath only sufficiently large to allow for the ordinary flow of the creek. The high water at the time of floods will pass over the top of the ford. This creek raises and falls very quickly and it is seldom more than a couple of hours after reaching high point until the water is again down to normal. The location is such that there is no time during the year but that the ford could be used if the other part of the road in its present condition was usable.

This will not be the first use made of the concrete ford in Iowa, but the examples of this kind are so few that they are worth mentioning. Wherever tried out they have proven very satisfactory, says the Service Bulletin of the Iowa Highway Commission.

CONCRETE SIGN BOARDS FOR ILLINOIS MAIN HIGHWAYS.

Illinois has adopted a concrete sign for main highway routes. The head of the post is 4 ins. thick, 12 ins. wide and about 20 ins. high. The outline of the state is grooved in the material and then painted in black. The number of the highway appears at the top of the sign. A third figure below indicates the location of this marker in the system and this corresponds to the number which appears upon the state map indicating that particular point on the map. This number indicates the approximate mileage from eastern and northern terminals of the route. The letters "L" and "R" are used to indicate left and right turns. The posts have a total height of 8 ft. and are embedded in the shoulder of the road to the depth of 3 ft. so that the post stands 5 ft. above the ground.

WATER WORKS SECTION

ICE TROUBLES IN THE ST. LOUIS, MO., WATER WORKS

By Cornelius M. Daily, Engineer in Charge, Supply and Purifying Section, Water Division, St. Louis Department of Public Utilities, 34 East Grand Ave., St. Louis, Mo.

Since 1895 the St. Louis water supply has been taken from the Mississippi River at the Chain of Rocks, and from that date trouble has been experienced, every severe winter, with ice entering the supply tunnel and lodging in the wet well from which the pumps draw their supply.

The old intake tower is located 1,500 ft. west of the Missouri shore in the deep channel, where it acts as a buffer to floating ice, and the ports are now protected from ice entering them with only a floating timber boom. The new intake tower is located about 500 ft. farther east than the old one. The ports are not protected in any way against the admission of ice.

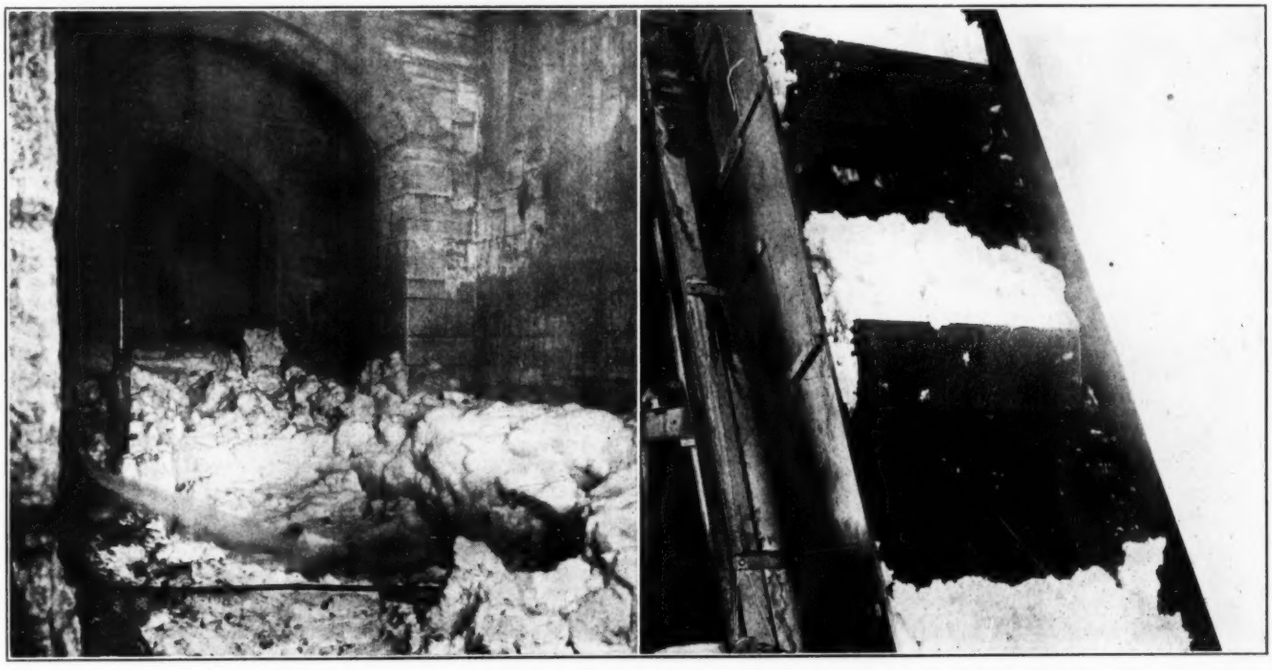
Ice Troubles from 1901 to 1917

The problem of preventing the ice from entering the supply tunnel has been given much thought by all Water Commissioners and their assistants since the plant was put in operation, as shown by the following extracts from the Water Commissioner's annual reports:

1901.

"In my report last year I referred to a timber floating boom which was placed at the inlet tower to fend off ice in winter. Our first winter with this boom showed it to be very useful in turning the main body of running ice away from the intake. There is, however, another trouble which comes from ice and which our present arrangement of boom and curtain barge does not meet. When the temperature approaches zero the water of the river is full of minute crystals of ice. These will go where the water does. In our plant they pass through the tower and tunnel to the wet-well. In the wet-well the crystals rise to the surface forming mush ice. Until a year ago this ice was removed from the well by thawing out with steam pipes. The amount of steam used in this way was at times very great, more steam being used for this purpose than for running the pumps while the trouble lasted. To avoid this strain in our steam plant, a scheme was devised to remove the mush ice from the wet-well by means of an endless chain elevator, driven by a small steam engine. The scheme was executed successfully. The machinery was assembled in December, 1900, and was ready for service on Jan. 15, 1901.

"On Jan. 23, 1901, it was tested and found to remove the mush ice at the rate of about 10 to 15 cu. ft. per minute. The ice was delivered automatically into dump cars and finally dumped on the river bank. So far as tried the ice hoist has worked successfully, but the winter has been a mild one and there was little opportunity to use the machine. It is believed, however, that the



SHOWING TYPICAL ICE CONDITIONS IN THE WET-WELL OF ST. LOUIS WATER INTAKE SYSTEM AND BUCKET ELEVATOR FOR REMOVING ICE IN OPERATION.

Printed as insert to Municipal and County Engineering, Chicago, Ill., August, 1920.

ice hoist will be a decided gain to the Department in keeping our pumps supplied with water in the severest weather."

1904.

"An unprecedented amount of trouble was experienced at the wet-well on account of ice coming through the tunnel during the extreme cold weather. The ice elevator at the south end of the wet-well broke down at the beginning of the cold weather and could not be repaired owing to the impossibility of emptying the wet-well at the time. Two derricks with hoisting engines were placed at opposite ends of the wet-well and were kept running continuously as long as ice came in. These engines were used altogether 26 days, hoisting 500 to 600 cu. yds. of ice per day. The expense amounted to about $5,000.

"Plans are being made for building a new elevator at the north end of the wet-well and also for repairing the old one at the south end, so no further trouble may be anticipated from that source.

"Pipe and sewer connections for washing away the ice have been made."

1910.

"The unusually long and severe winter materially increased the cost of keeping the gates at the intake tower free from ice, this item amounting to $1,256.46. The early gorging of the ice below Chester, extending up as far as Sawyers Bend, eventually raised the stage of the water temporarily obviating all difficulties, but rapidly-moving ice packs following the breaking of the gorge and the resulting fall in river level so damaged the timber boom as to render it unfit for further service. At the later lower stages the ice closely hugged the east face of the tower, not being warded off by the boom, partially blocked the drawing gates and compelled the opening of the unscreened emergency gate, thereby admitting large lumps to the tunnel and increasing the quantity to be handled by the conveyors in the wet-well. The cutting of an opening in the southwest corner of the tower at an elevation as low as the present emergency gate with the continuation of a necessary dike or breakwater west of the tower, extending from bed rock to elevation 85, at which stage there is little trouble, for purpose of diverting ice floes away from the tower would, in connection with the boom on the east side, as has been the practice, tend to minimize any further trouble. The cutting of the east bank of the river above the tower has changed the direction of the current slightly, so that where it formerly was parallel to the tower it now strikes the east face at a slight angle. This has in some measure, at least, increased the quality of ice to be handled at any stage."

1911.

"The timber of the old boom built in 1900 and which has been in service since, were so badly decayed as to need replacement throughout.

"An ice deflector, made up of 12x12 in. timber faced with ¼ in. steel extending from elevation 90 to river bed and projecting out into the stream 5 ft., was securely fastened to the east face of the tower, north of the north gates, at a cost of $934.81. The year gave no opportunity for a test of its efficiency, ice troubles of low river stages being prevented by other means."

1912.

"The most serious situation the Department has faced in years was caused by an accumulation of slush ice and frazil in the wet-well following a break-down of the two ice machines Sunday evening, December 21. Beginning next morning, derricks were ready to handle the ice and the north conveyor repaired and run for a few days until it broke again, but it was not until ten days later that the well was cleared of ice. The cost was $16,600; $9,820 of which was for labor alone.

"The deflector placed on the east side of the tower last year proved unsatisfactory at the higher stages of water. It is proposed to replace it with a boom and to supply timber curtain of varying depth for use as a further safe guard."

1913.

"Practically no troubles were experienced from ice this year. The stage of the river when ice was floating was such that the boom and a floating curtain constructed

VIEW OF OLD INTAKE TOWER OF ST. LOUIS WATER WORKS SHOWING ICE CONDITIONS AND TIMBER FLOATING BOOM FOR FENDING OFF ICE FROM ENTERING SUPPLY TUNNEL.

by the tower-keeper deflected most of it away from the gates and only a little needle and slush ice came to the gratings over the gate ports."

1916.

"With both towers in operation ice troubles were minimized, there being more than 1 ft. of slush ice in the well only during one period of 4 days."

1917.

"Ice troubles during the winter have been minimized by low river stages, but between Dec. 13 and Feb. 21 a force of from 3 to 4 men at the new tower and from 4 to 8 men at the old tower have been on duty at all times."

The unusual cold winter beginning Dec. 8, 1918, and continuing until March 1, necessitated keeping a force of men at the towers and in the wet-well the greater part of the time to prevent the ice from shutting off the supply of water. Six men were kept at No. 1 tower and two men at No. 2 tower. In the wet-well the number of men varied from none to twenty. At times the two bucket ice hoisting machines in the wet-well were unable to remove the ice as fast as it came in, and on Feb. 21 and 22 ice collected to a depth of 16 ft. all over the well, this serious condition lasting for a period of twelve hours.

The cost of removing the ice from the wet-well during the winter of 1917-18 was $1,418.07, exclusive of the cost of power, water used in washing the ice into the river and the engineman's wages.

Steam Introduced in 1918

In 1918 plans were made to introduce steam into the new tunnel in the uptake shaft on the river bank a distance of 560 ft. from the wet-well in such quantities as may be necessary to raise the temperature of the water in the tunnel a small fraction of a degree, enough to prevent the formation of ice. The plant was installed in the fall of 1918. When operating the steam will be run direct from the boilers through a 4-in. pipe to the uptake shaft and delivered into the tunnel, where it will have a distance of 560 ft. to travel and mix with the supercooled water before reaching the wet-well.

Further study of ice troubles were made during the winter of 1918-19 at the new tower when large quantities of ice were carried into the tunnel (the gate on the west side being open) in the form of slush and needle ice. The temperature of the water at this time was found to be 32.2 degrees Fahrenheit. The current was not parallel to the faces of the tower but struck it on the west side at an angle of about 10 degrees. Immediate relief was obtained by opening the gates on the east side and closing those on the west. This operation was performed several times to verify the conclusion that masses of floating ice, on striking the tower, were broken up and the clinging frazil and slush ice was carried by the suction of the water into the tunnel through gates 15 ft. or more below the surface. It will be very difficult, if not impossible, to prevent large quantities of ice being carried into the tunnel at the new tower when fields of floating ice strike it. The advantage gained by increasing the velocity of the current by contracting the channel with the hurdle dikes is, in this respect, lessened.

Production of Frazil Ice

Ice troubles always follow a sudden fall in temperature, approaching zero or lower, in the upper river valleys, when the river is not frozen over at the towers. There are five conditions favorable to the production of frazil ice which is the chief cause of our ice troubles, namely, low temperature, clear water, open river, strong wind and snow or sleet; these conditions produce supercooling of the water to a fraction of a degree; the water entering the tunnel is under increased pressure of nearly two atmospheres which prevents any formation of ice and the consequent rise in temperature which would otherwise occur, due to the increased agitations; but on reaching the wet-well the agitation continues and the pressure is reduced, causing the frazil ice to form and the temperature to rise to the freezing point.

No advancement in the art, or science, of separating ice sediment and water has been made since 1901, when the timber boom was constructed to fend off the floating ice and the bucket elevators were installed to remove the ice collected in the wet-well.

The problem is difficult because of sediment carried by the current. If the velocity of the water was checked at the tower the ice would come to the surface, but the sediment would fall to the bottom, forming a barrier to water entering the ports which might be harder to overcome than the removal of the ice would be.

An ordinance appropriating money to reconstruct Homer's Dike, raising it to Elevation 83 became effective in May, 1920, and a letting was held June 22, 1920, for doing the work. When this dike is reconstructed the water above the dike will flow by the old tower from which the supply will be drawn and in severe weather that portion of the river freezes over and the water flowing beneath will be free from frazil ice. At the present time the water flows over the low portion of the dike and the supply for the old tower is drawn from the channel of the river, which is laden with ice in extreme cold weather.

The new intake tower presents a more difficult problem, owing to the greater depth of water and a swifter current there.

Various ways have been suggested but a satisfactory solution of the ice troubles has not been found.

Satisfactory Solution of Problem Not Yet Found

The introduction of steam into the tunnel to melt the frazil ice has been successful as far as carried, but the amount of steam used never exceeded 10,000 lbs. per hour, which is less than one-half the amount required to melt the quantity of ice which came into the wet-well during ice troubles in 1918, estimated at 2,200 lbs. per minute, and raise the temperature of 160,000,000 gals. of water per day one-tenth of one degree Fahr. The B. T. U. required for this work is 24,700,000 per hour, requiring the burning of 40 to 45 tons of coal per day.

As an emergency measure, melting the ice is satisfactory but for economical operation a better solution is sought.

NOVEL AND ECONOMICAL MIXING DEVICES FOR APPLYING CHEMICAL COAGULANT TO WATER RECOMMENDED AFTER TESTS AT MILWAUKEE

By Joseph W. Ellms, Consulting Engineer, Cleveland, Ohio.

(Editor's Note:—After conducting extensive experiments on the purification of the water supply of Milwaukee, Wis., Mr. Ellms recommended the construction of a rapid sand filtration plant of a capacity of at least 160 million gallons per day, to purify the raw water supply drawn from Lake Michigan. He recommends chlorination of the filtered water. He recommends, also, that in designing the filter plant advantage be taken of certain information gained in the experimental work, namely, that adequate mixing of coagulating chemical solutions with the water may be obtained in comparatively simple devices of much less cost than those now commonly employed. The following matter is from Mr. Ellms' report and pertains to the novel and economical mixing devices for applying the chemical coagulant, upon which he conducted experiments, and which he recommends.)

A feature of rapid sand filter plant design which has some times received little or no attention, and at others improper treatment, is the manner in which the chemicals are applied to the water to be coagulated. It is believed that the correct method can only be developed when there is a proper understanding of the chemical reactions in-

volved, and of the physical phenomena which follow these reactions.

As all chemical reactions of the type utilized in coagulating water are extremely rapid, their velocity increasing with increasing temperature, it merely becomes a matter of bringing together as quickly as possible the reacting compounds. Since the volume of the chemical solution (or solid where dry feeding is used,) is very small as compared with the volume of water to be treated, it is apparent, that in practice it becomes a mechanical problem of bringing the reacting substances together.

The device which has been widely used to effect this mixing, more especially where softening the water is the object sought, is what is known as a mixing chamber. These chambers usually consist of a series of long, narrow channels, sometimes baffled vertically, and sometimes not baffled, but practically depending upon the velocity and length of travel of the water to effect the mixing action.

The experimental mixing chamber used in this investigation is described herewith, as are also the other devices used to produce rapid and thorough mixing. These other devices are all believed to be more or less novel, and departures from existing practice. That they are simpler, and very much less expensive to construct, is obvious. How well they did the work for which they were designed is shown.

Four Types of Mixing Devices Tested

Four different types of apparatus for mixing the coagulating chemical solutions and the raw water were installed. They are described in detail as follows:

Mixing Channels or Chamber.—A mixing chamber provided with baffles of "around the end" type, occupied nearly the whole of one side of the building. It was 60 ft. by 11 ft. and 9 ins. in plan, and contained 22 channels. The channels were each 60 ft. long and had a cross-sectional area of approximately 13 ins. in depth by 5½ ins. in width. The channels were arranged in steps with a total drop from the highest to the lowest channel of 2 ft. and 5 ins.

Fish Ladder.—In this apparatus a compact mixing device was produced by placing short "around the end" baffles in a narrow but rather tall vertical tank. The height of the tank was 7 ft. and its dimensions in plan 1 ft. by 3 ft. It contained 17 baffles placed 4 ins. apart. The passing space around the end of the horizontal baffle was 4 ins. by 1 ft. in area. A distance of 6 ft. existed between the level of the water entering the device and the usual level in the settling basin.

Fall.—A simple mixing device of another type designated as the "fall" consisted merely of a wooden box 4 ft. by 4 ft., in plan, and 3 ft. deep. Near the top and extending the whole width of one side was a receiving tray approximately 10 ins. by 10 ins. in cross section. The water was discharged into this tray, together with the coagulant solution, and spilled over the side to an apron set at an angle of about 45 degrees and which had two 1-in. high riffle strips extending across the whole width of the apron. The water fell from the apron on a pile of stones in order to still further agitate the flow.

Flume.—A further elaboration of the idea embodied in the "fall" was produced by the construction of a riffled flume. This mixing device consisted of a trough or flume 28 ft. long, 2 ft. wide and 1 ft. deep. It contained 13 riffles 6 ins. high and set 2 ft. apart throughout the length of the flume. The flume was set at an angle so that the water had a drop of about 4 ft.

TABLE I.—SHOWING VELOCITY AND LOSS OF HEAD IN FLOW OF WATER THROUGH VARIOUS MIXING DEVICES

Name of Device	Rate of Pumpage in Gallons per Day	Number of Feet of Travel	Time of Travel Mins.	Time of Travel Secs.	Velocity in Feet per Sec.	Loss of Head in Feet
Mixing Chamber.....	125,000	1320	18	45	1.17	2.41
Mixing Chamber.....	125,000	720	10	22	1.16	1.38
Mixing Chamber.....	250,000	720	8	40	1.39	1.58
Mixing Chamber.....	250,000	360	4	5	1.48	0.79
Mixing Chamber Mod..	250,000	109	1	10	1.56	0.69
Mixing Chamber Mod..	250,000	218	2	23	1.52	1.38
Fall.....	250,000	3.9	0	10	0.39	2.30
Fish Ladder.....	250,000	59.5	0	45	1.32	2.60
Flume.....	250,000	27.3	1	15	0.36	4.00
Flume—Fall.....	250,000	18.6	0	50	0.37	3.00
Flume—Jump.....	250,000	12.0	0	1.3	9.00	1.75

Remarks—In original mixing Chamber each of the 22 channels was 60 feet long. When modified each channel was 18.9 feet long.

Results

Table I shows the velocity with which the water moved through these various devices for different rates of pumpage. Measurements of velocity were made with floats, and also by means of a salt solution. The losses of head are approximately correct in most cases. Most of these losses are well within that which good design would permit, but some of them are doubtless too high.

The poorest mixing action was obtained with the "fall"; some improvement was effected after changes were made in the manner of introducing the chemical solution, but on the whole its action was rather unsatisfactory. Somewhat better results were obtained with the "fish ladder," but as this device is in reality an "around the end" baffled mixing chamber placed vertically, it offers no particular advantage except in taking up but little space.

It was observed when using the mixing chamber that prompt coagulation, which is, of course, an indication of the completeness of the mixing, took place in the first 5 or 6 channels, but that the size of the floc had decreased as the water passed through the lower channels. In some cases the flocculation did not make its appearance until 7 or 8 channels had been passed, reaching its best condition in the 10th and 12th channels. The long travel, however, appeared unnecessary and even harmful in breaking up the floc.

In order to see whether reduction in the size of the flocculated particles was due merely to the velocity acquired in the straight channels, or was caused by the agitation of the water as it reversed its direction of flow at the ends of the channels, the latter were blocked about 18.9 ft. from the end and new openings cut through the baffle walls. The same number of reversals of the direction of flow was obtained, but the length of travel in each channel was cut down from 60 ft. to 18.9 ft.

The results were as satisfactory as those previously obtained, but no more so, although nearly 70 per cent. of the chamber had been cut out of service.

The "flume" as originally designed, consisted of an inclined trough provided with low weirs placed 2 ft. apart. The water in flowing down the flume formed a series of cascades. An excellent mixing action was produced at a comparatively low velocity of flow. The loss of head, however, was too great. By cutting the "flume" into two parts and attaching the box known as the "fall," the loss of head was cut down about 25 per cent. The results obtained were good and were secured with a low

rate of flow. The device takes up little room as compared with a mixing chamber.

In the last device an entirely new principal was utilized. By removing the weirs from the "flume," extending it slightly into the receiving box ("fall"), and placing a low weir at the end, there was produced by the rapid flow of the water down the "flume" a "hydraulic jump." By the impact of the water flowing down the "flume" into the pool back of the weir, a turbulent condition of the water was produced, which effectively mixed the chemical solutions and the water. The chemical solutions were applied at the head of the "flume." The water acquired a velocity of 9 ft. a second in flowing down the "flume," but this velocity was practically all dissipated in complex eddies, at the "jump." Considerable air is trapped in the "jump," and its escape contributes materially to the turbulent condition of the water and consequently improves the mixing action.

The results with this device have been very satisfactory, and the reason for it requires explanation. When a precipitate is the product of a chemical reaction, it first appears in a very finely divided condition. In the case of a colloidal precipitate such as ferric hydroxide or aluminum hydroxide (the two compounds utilized in water purification,) the aggregation of these particles into larger masses is necessary, not only to entrap the fine sediment and minute bacteria in the water, but to prevent them from passing through the sand bed of the filters. It is obvious that violent and continued agitation of the water will hinder rather than assist in this clotting together of these particles, and hence, to aid this coagulation, a quiescent condition is necessary.

The "hydraulic jump" mixing device provides an extremely rapid and thorough mechanical mixing of the chemical solution and the water to be treated, thereby bringing the reacting substances together and hastening the reaction. Immediately following the "jump" the water flows quietly to a settling basin in which the physican action of coagulation can take place with the least possible amount of agitation and thereby reduces to a minimum the breaking up of the floc during its formation.

The proper mixing of the chemicals with the water, and the chemical and physical conditions resulting have been discussed in some detail because of its importance in the design of a plant. By the adoption of a simpler design a great deal of money may be saved in the construction costs.

Another factor in the problem of properly coagulating a water of as low average temperature as that of the Milwaukee water supply, has also been given considerable attention. The low temperatures undoubtedly do retard coagulation, and it has even been claimed that for this reason the water supplied to Milwaukee could not be properly prepared for filtration. While the floc formed in the coagulated water has at all times been quite small, it has never failed to produce the requisite thickness of colloidal mat on the surface of the sand of the filters.

So far as effective mixing, and proper coagulation are concerned, the experiments have proven conclusively, that devices can be designed which will effectively handle the water supply of the city, and that their cost of construction will be much less than some of those now commonly employed.

THE ECONOMY RESULTING FROM THE USE OF VARIABLE SPEED INDUCTION MOTORS FOR DRIVING CENTRIFUGAL PUMPS

By Prof. Melvin L. Enger and Mr. William J. Putnam, College of Engineering, University of Illinois, Urbana, Ill.

The centrifugal pump is inherently a variable speed machine. Fig. 1 shows the relations between quantity, head and speed in the case of a typical centrifugal pump. An examination of the figure will show that when any two of the three variables are selected the third is determined. For example, if the speed and quantity are chosen the head is determined. With the usual arrangement of an induction motor direct-connected to a centrifugal pump the speed is fixed. The speed of an induction motor is not quite constant, but decreases with increasing loads, affecting the relation of the head and quantity delivered by the pump somewhat as indicated

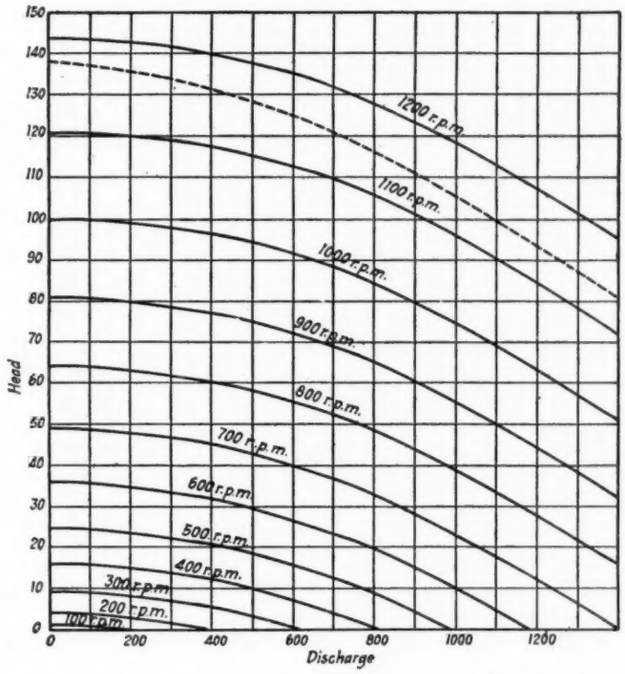


FIG. 1—RELATIONS OF SPEED, DISCHARGE AND HEAD WITH A TYPICAL CENTRIFUGAL PUMP.

by the dotted line in Fig. 1. The variation in speed is so small, however, that the induction motor is usually considered to be a constant speed machine.

Four Conditions Under Which Pumps Operate.

There are four general conditions under which pumps operate: (1) Constant discharge against a constant head; (2) constant discharge against a variable head; (3) variable discharge against a constant head, and (4) variable discharge against a variable head. The first condition is the ideal one for centrifugal pumps, driven by constant speed motors. Pumps delivering water to filter plants or to surface condensers often fall into the second class. The third condition is probably a rare one. In the fourth class would be included pumps used in water

works plants for delivering water into distribution systems, because in this case variations of the water level in reservoirs and elevated tanks cause the head to vary, while variations in demand cause the quantity delivered by the pump to vary. In the last three cases it is customary to select motor-driven centrifugal pumps, operating at constant speed, which will operate satisfactorily under the most adverse conditions, and to control the head and discharge by valves at all other times.

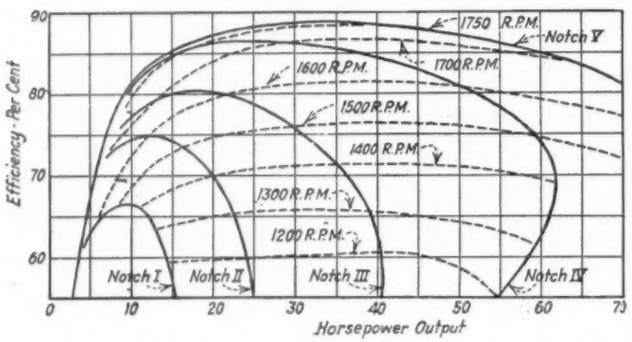


FIG. 2—CURVES SHOWING RELATIONS OF HORSEPOWER OUTPUT EFFICIENCY AND SPEED OF A WESTINGHOUSE 50 H.P., 440 VOLT, 60 CYCLE, 2 PHASE, VARIABLE SPEED INDUCTION MOTOR.

The variable speed induction motor has a wound rotor with its terminals connected to slip rings so that resistances may be introduced into the rotor circuit to change the speed. The action is somewhat analogous to slipping a clutch to secure lower speeds, and is, of course, wasteful. In the Standard Handbook for Electrical Engineers it is stated concerning the variable speed induction motor:

"For any one value of the resistance the speed changes greatly with variations of load and rises practically to synchronous value at no load, whatever the resistance. The higher the resistance the more the speed will vary for a small change in load. An amount of power proproportional to the speed reduction is lost in the resistance, that is, if the speed is decreased to 30 per cent. below normal, 30 per cent. of the energy taken from the line is lost."

Fig. 2 shows the relations between horsepower output, efficiency and speed of a 50-horsepower Westinghouse variable speed induction motor used for driving a DeLaval three-stage centrifugal pump in the Hydraulic Laboratory of the University of Illinois. The results of the test of this motor bear out the statements quoted above.

When the head developed by the pump is in excess of the head required under the given condition of speed and discharge, the excess head is usually wasted through a partly closed valve. The power input to the pump remains unchanged because the pump continues to deliver the given quantity of water against the same head no matter how much the valve is throttled. The power used in producing the excess head is wasted. If, however, the speed of the pump is reduced to the proper amount it will not be necessary to waste head through a valve. The head developed by a centrifugal pump varies as the square of the speed when the discharge is zero, and varies approximately as the square of the speed for any discharge within the usual range of operation. If the speed is reduced to 90 per cent. of the original speed the head will be reduced to about 81 per cent of the original head. If this change of speed is accomplished by means of a variable speed induction motor, the efficiency of the motor will be reduced to 90 per cent. of the original efficiency. The efficiency of the pump usually does not change materially within such a range of operation. If the head be reduced to 81 per cent. of the original head by throttling a valve the over-all efficiency will be reduced to 81 per cent. of the original over-all efficiency. That is, the use of the variable speed motor to decrease the head to 81 per cent. of the original value reduces the over-all efficiency by 10 per cent., as compared with a reduction of 19 per cent. in case a valve is throttled.

Example of Saving Effected.

In the case of a motor-driven pump having an over-all efficiency of 55 per cent., delivering 1,000 gals. per minute against a maximum head of 100 ft., but operating against a head of 90 ft. half of the time, a saving of about $150 a year would be effected by the use of a variable speed induction motor instead of a squirrel cage motor, it being assumed that power costs 2 cts per kw. hour. Approximately the same annual saving would be effected by the use of a variable speed motor with a pump of the above capacity and efficiency for any maximum head, provided that the pump operates half of the time at a head 10 ft. less than the maximum.

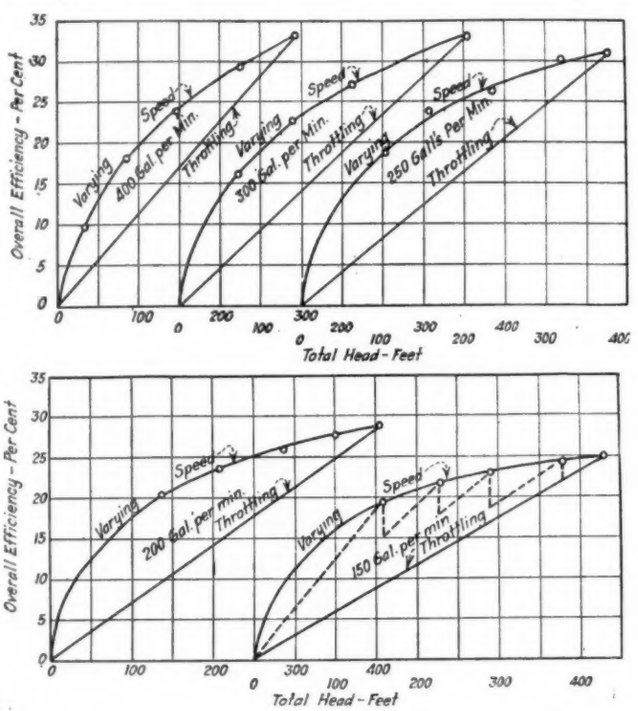
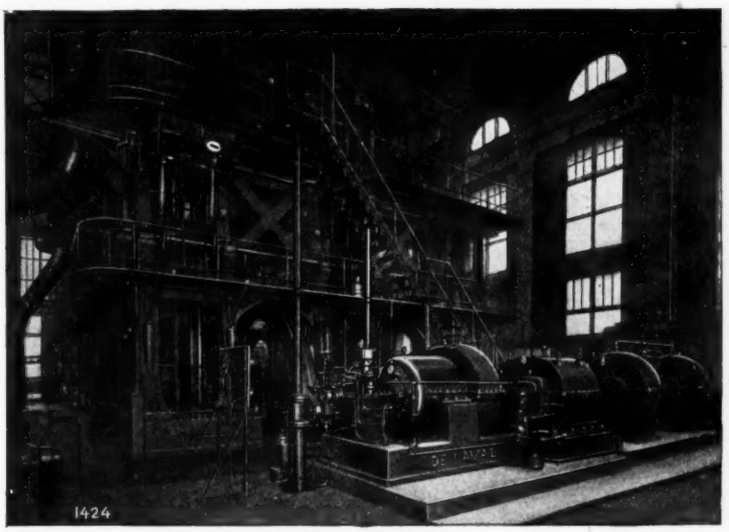

Overall Efficiency - Per Cent
Total Head - Feet
Varying Speed
400 Gal. per Min. Throttling
300 Gal. per Min.
250 Gallons Per Min.
200 Gal. per min.
150 Gal. per min.

FIG. 3—TESTS SHOWING RELATIVE OVER-ALL EFFICIENCIES OF A MOTOR-DRIVEN THREE STAGE CENTRIFUGAL PUMP FOR VARIOUS HEADS AND DISCHARGES WHEN THE SPEED IS VARIED AND PUMP RUN AT NORMAL SPEED WITH DISCHARGE THROTTLED.

Fig. 3 gives the results of tests on a DeLaval three-stage centrifugal pump direct-connected to a Westinghouse variable speed induction motor. The over-all efficiency of the unit when delivering various quantities



Less Overhead on De Laval Geared Turbine-driven Centrifugal Pumps

THE above photograph of the De Laval unit installed in the Turkey Creek pumping station of Kansas City, Mo., designed to pump 20,000,000 gal. per day against 370 ft. head, shows quite plainly why reciprocating pumps were out of the running. The triple-expansion unit to be seen immediately in the rear of the turbine also has a capacity of 20,000,000 gal. per day against 370 ft. head.

It is obvious that the cost of the centrifugal unit was many times less. It occupies less floor space, weighs much less, requires less expensive foundations and does not extend nearly so far below and above the floor. A high building is not needed to house it nor a heavy crane to overhaul it and it does not require that the building be heavy and substantial.

The casing covers of the turbine, gear and pump are light and easily handled, and upon removal give access to all internal working parts.

While the reciprocating unit has numerous valves, packings and steam valve gears, calling for constant attention for upkeep and adjustment, the turbine-driven pump is simple and requires little attention.

On the reciprocating unit there are innumerable points, including steam cylinders, requiring independent lnbrication. The bearings and gears of the centrifugal unit are lubricated automatically, the same oil being used over and over.

The duty of the reciprocating unit falls off rapidly due to slippage. The duty of the turbine-driven unit is high because of its ability to utilize high superheat and vacuum, and is maintained in service.

To sum up, the De Laval turbine-driven centrifugal pump handles water at the lowest cost.

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of water against various heads is shown when the speed of the unit is varied and also when the unit is run at normal speed and the heads are obtained by throttling the discharge valve. It will be noted that the saving in power effected by the use of the variable speed motor is large when considerable reductions of head are required. The motor driving the pump was arranged for only five running speeds. The smooth curves drawn through the points indicate the over-all efficiency if the resistances introduced into the rotor circuit could be made any desired amount. For the unit used in the tests it is necessary to throttle the discharge valve to obtain heads between those given by the five running speeds. The over-all efficiency for different heads is, therefore, as indicated by the dotted lines in the tests with the discharge of 150 gals. per minute.

In the selection of a variable speed motor to drive a centrifugal pump great care should be taken that the several speed changes shall all be within the range required to produce the specified range of head, and the more speeds within this range the better. The electrical manufacturing companies might well turn their attention to developing an external resistance having a large number of steps.

The resistances consist of cast-iron grids compactly arranged, and are connected with the motor through a controller of the type used on street cars. Considerable heat is developed in the grids when the motor is operated at the lower speeds. The grids should, therefore, be located where the heat generated will not be objectionable. Unless the operator is instructed concerning the advantages of the use of variable speed he is likely to conclude from the heat developed in the grids that it is better to throttle the discharge by means of a valve, because the energy loss in this case is not so apparent, although it is in general about twice as great.

The variable speed induction motor is more expensive than the ordinary squirrel cage motor, but the saving in power resulting from its use, when the head varies considerably, will much more than pay the interest and depreciation on the additional investment.

The foregoing paper by Messrs. Enger and Putnam was presented at the 1920 annual meeting of the Illinois Section of the American Water Works Association.

DEVELOPING HIGH OVERLOAD CAPACITIES WITH HORIZONTALLY BAFFLED BOILERS.

Modern industrial boiler plant practice at present shows a marked tendency toward the use of larger and more efficient units in order to avoid the labor troubles, shut-downs, and standby losses experienced with low capacity and uneconomical equipment. In some instances, this is achieved by rebuilding the boiler house, installing up-to-date high duty boilers, and by introducing the proper machinery for handling coal, ashes and feed water.

In one of the largest textile mills of the country, for example, five 950 H. P. horizontally baffled water tube boilers and superheaters set with underfeed stokers have been installed, to replace 17 250 H. P. and 4 275 H. P., a total of 21 fire-tube boilers equipped with hand fired grates. The water-tube boilers have been in operation for about two years under conditions of unusually severe and continuous service and have fully demonstrated, through satisfactory performance the advantages of units of this size and type. Whereas 10 firemen, 5 water tenders, 2 repair men and 1 foreman were required formerly, the present force consists only of two men, one to watch the boilers and the other to operate a coal crane.

The present article describes briefly a series of four tests conducted on one unit of the installation to ascertain whether an arrangement of the horizontal baffling

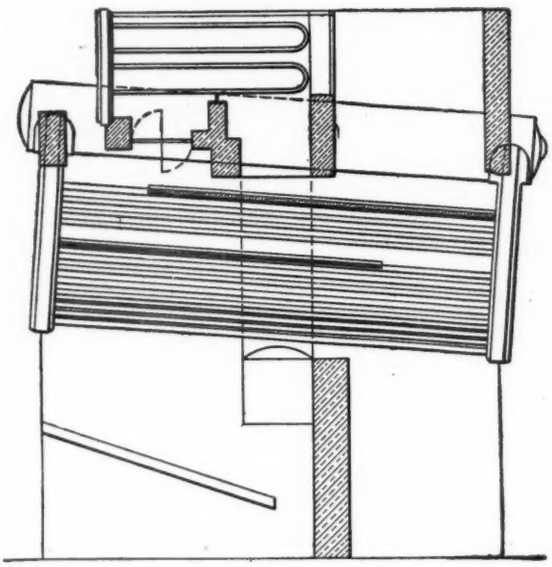

FIG. 1. 950 H. P. HEINE THREE-DRUM WATER TUBE BOILER EQUIPPED WITH SUPERHEATER.

suitable for attaining high capacities would prejudice the efficiencies obtainable at lower ratings.

The tests were run under the usual working conditions prevailing in the plant in order to get results which would represent the commercial performance to be expected in industrial service from large stoker-fired boilers of this type. Nothing was "polished up" in order to get record-breaking results. At the time of the trial, the boiler tested had been in continuous service for 3½ months.

All of the plant load, in excess of the capacity developed by the unit under test, was handled by three of the other boilers operated at moderate rating by the regular boiler room force.

The fuel burned was taken at random from the large tonnage in storage at the plant and comprising many deliveries from various sources. The results of analysis indicated that this was only a fair grade of low-volatile Pennsylvania coal, typical in quality of the vast quantities of similar fuel delivered to the New England mills during the past two years.

The boiler tested was a standard Heine horizontally baffled boiler set as shown in Fig. 1. The arrangement of baffling should be particularly noted. It is simple and inexpensive to repair, replace or to change in location. Such modifications are often advisable if high efficiency is to be maintained with different furnace conditions re-

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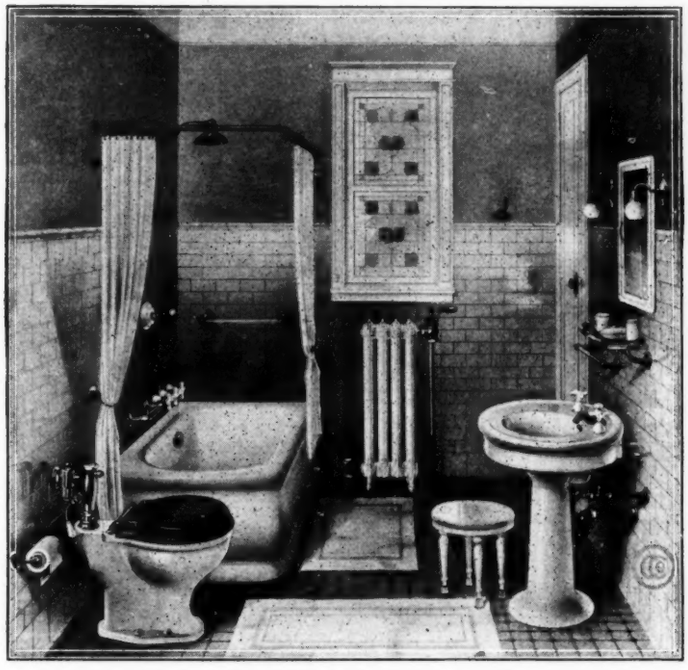

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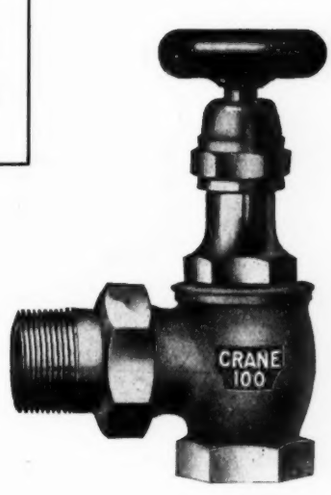

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sulting from a change of fuel or operation. The principal dimensions of the boiler are as follows:

No. of steam drums.....3
Diameter of steam drums.....42 ins.
Length of steam drums.....20 ft. 9 ins.
No. of tubes.....551
Diameter of tubes.....3.5 ins.
Length of tubes.....18 ft.
Water heating surface.....9500 sq. ft.
Superheating surface.....633 sq. ft.
Grate surface including dump grate....147.4 sq. ft.
Ratio of water heating surface to grate surface.....64.5 to 1
No. of Riley stoker retorts.....10

A thorough examination of the boiler, superheater, setting and stoker was made before and after the tests were run. The boiler was found to be free of all leakage, and deposits of soot or slag on the heating surfaces. There was some scale in the tubes which increased in thickness from nothing in the upper tubes to 1-16 in. in the lower ones. The brickwork of the furnace, setting and superheater was in good condition. The baffling was intact and tight. The Riley Stoker was in excellent mechanical condition throughout the tests.

The method of conducting the boiler trials was that prescribed by the A. S. M. E. Code. All instruments and scales were compared with standards. The calibration of the water measuring tanks was checked by independent observors.

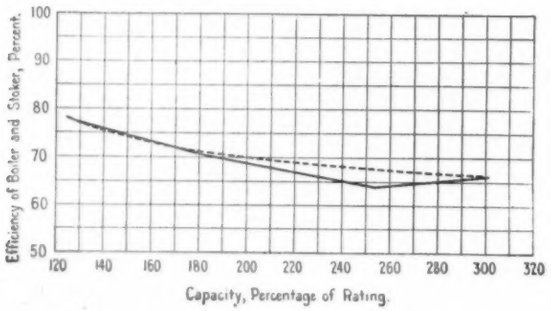


FIG. 2. EFFICIENCY CHARACTERISTIC OF BOILER AND STOKER.

The coal was weighed by a sealed scale carrying an overhead hopper of 2,000 lbs. capacity, from which it was transferred as required through a chute to the stoker hopper. The scale was provided with a self-registering beam. Duplicate tickets were made at each weighing. The coal analyses, Table 1, were made from carefully worked down samples of 500 lbs. taken from the crushed coal during each test. All stoker siftings and samples were weighed back. The ash analyses, Table II, were made on samples representing the entire quantity of refuse as weighed down in the usual manner. At this point it may be well to direct attention to Tables I and III, and to the discrepancy in the percentages of moisture in the coal for Tests 1, 3 and 4. The values given in Table III, with the exception of that for Test No. 2, are correct for coal as fired. They were determined by drying representative samples of coal during the tests. No determination of moisture content was made during Test No. 2, but the analyzed percentage was accepted

TABLE II.—ASH ANALYSIS

	Sample 1		Sample 2	
	As received	Dry Basis	As received	Dry Basis
Weight all through ¾-in. screen.....	1.7 lbs.		2.0 lbs.	
Weight over 2 mesh screen.....	0.3 lbs.		0.4 lbs.	
Weight over 4-mesh screen.....	0.5 lbs.		0.9 lbs.	
Moisture	14.94		18.67	
Combustible	12.86	15.11	13.52	16.63
Earthy matter.....	72.20	84.89	67.81	83.37
	100.00	100.00	100.00	100.00

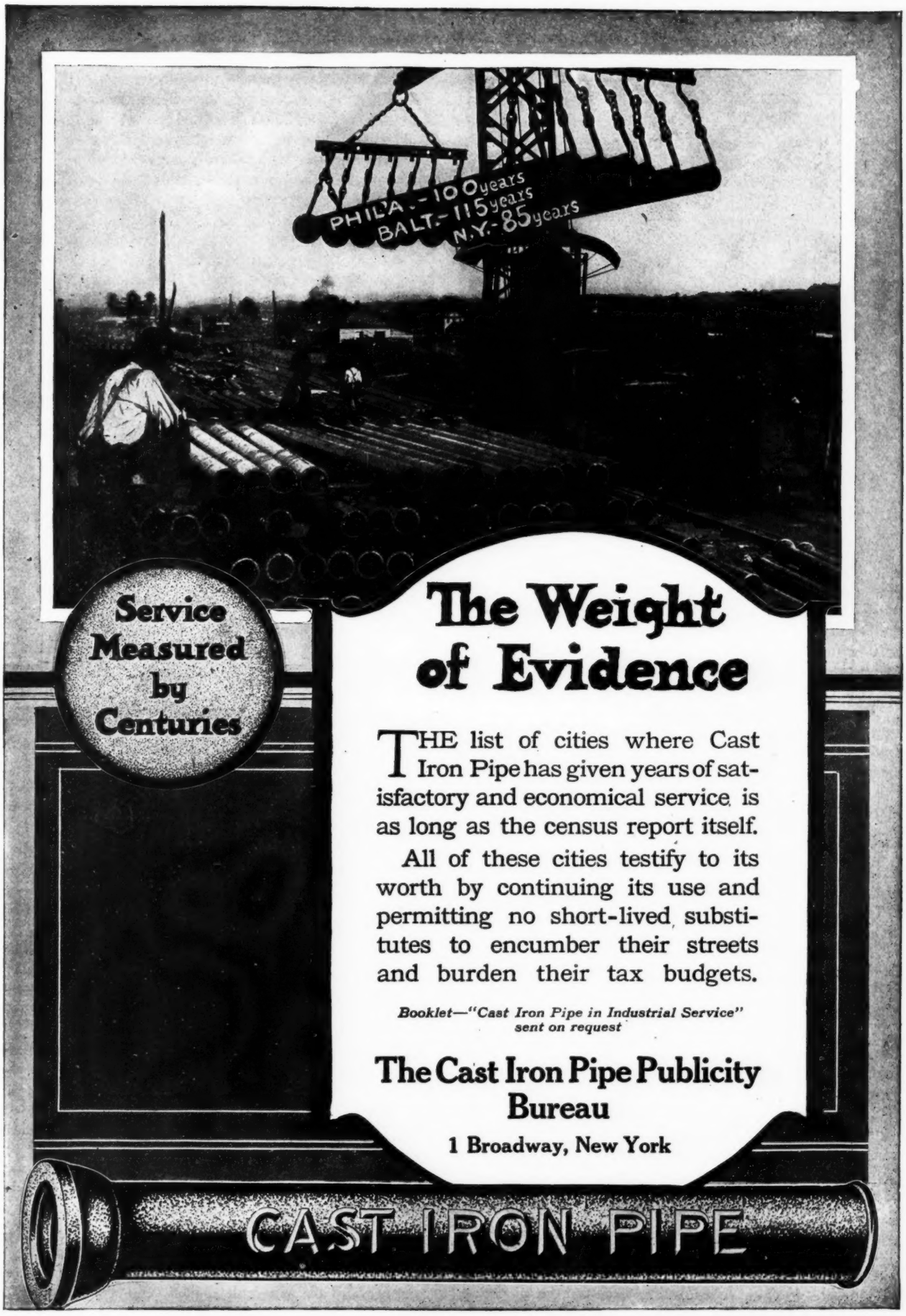
TABLE III.—SUMMARY OF DATA AND RESULTS

	Test 1 Sept. 30, Oct.,'19 24 hrs.	Test 2 Oct. 3-4,'19 21 hrs.	Test 3 Oct. 7,'19 3 hrs.	Test 4 Oct. 10,'19 3 hrs.
Steam pressure, gauge.....	134.0	130.0	140.0	141.2
Superheat, degrees	136.2	126.4	99.2	153.5
Feed temperature, degrees.....	127	127	125.5	129
Flue temperature, degrees.....	541	600	670.8	694
Pressure in wind box, inches...	2.63	4.3	6.2	6.46
Draft in Uptake, ins.....	.293	.75	1.18	1.25
Total coal fired.....	42,605	124,569	28,561	32,270
Per cent. moisture in coal.....	2.89	1.61	2.33	2.56
Total water fed.....	825,605	1,032,301	209,391	243,208
Factor of evaporation.....	1.208	1.204	1.192	1.217
Coal fired per hour.....	3,867	5,931	9,520	10,757
Coal fired per retort per hour..	386.7	593.1	952.0	1075.7
Dry coal per sq. ft. of grate surface, per hour.....	25.47	39.6	63.1	71.1
Water evap. per hour.....	34,400	49,157	69,797	81,069
Equivalent evap. per hour.....	41,555	59,185	83,198	98,661
Builders rated, horse power....	950	950	950	950
Boiler horse power developed..	1,250	1,716	2,411	2,858
Per cent. rating, developed.....	126.8	180.6	253.8	300.8
Water evap. per lb. coal as fired	8.89	8.29	7.33	7.54
Equiv. evap. per lb. dry coal....	11.07	10.14	8.95	9.41
B. T. U. per lb. dry coal.....	13,850	13,917	13,581	13,796
Per cent. ash, dry coal.....	10.91	10.54	12.23	11.19
Per cent. combustible in ash...	15.11	16.63	.....	.....
Combined efficiency	77.56	70.71	63.93	66.21

TABLE I.—COAL ANALYSIS

	Sample 1		Sample 2		Sample 3		Sample 4	
	As received	Dry Basis	As received	Dry Basis	As received	Dry Basis	As received	Dry Basis
Weight all through 2-mesh screen.....	1.6 lbs.		1.4 lbs.		*1.8 lbs.		1.7 lbs.	
Weight over 4-mesh screen.....	0.3 lbs.		0.2 lbs.		0:3 lbs.		0.2 lbs.	
Moisture	2.20		1.61		1.53		2.29	
Volatile matter.....	21.82	22.31	20.68	21.01	20.15	20.46	20.70	21.19
Fixed carbon.....	65.31	66.78	67.34	68.45	66.28	67.31	66.08	67.62
Ash	10.67	10.91	10.37	10.54	12.04	12.23	10.93	11.19
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Sulphur Separately determined.....	1.88	1.92	2.23	2.27	2.19	2.22	2.44	2.50
B. T. U., per pound.....	13545	13850	13692	13917	13373	13581	13480	13796

* All through ¾-in. screen.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as correct. The samples collected for analyses, (Table 1) dried somewhat during the working down process. If a sample for Test No. 2 had been dried out, it probably would have shown a slightly higher moisture content than 1.61 per cent. This greater value would have increased the efficiency for Test No. 2, and raised it into line with the values for Tests Nos. 1 and 4, as shown by the dotted curve of Fig. 2.

Feed water was measured in three carefully calibrated tanks holding an aggregate of 9128 lbs. of water at 130°F. The test boiler was provided with an independent feed pump and piping. Hot and cold water were available at the measuring tanks enabling the close maintenance of the feed water temperature.

Every percaution was taken in the feed and blow-off piping to insure the measurement of all water entering the boiler and to guard against any leakage.

The coal consumed and water evaporated were determined for each hour of the test to obtain the approximate rating developed. The rating was also observed by means of a General Electric indicating flow meter.

Readings of pressure, temperature, draft, etc., were taken at 15 minute intervals. Analyses were made for CO2, CO and O2 in the furnace flue gases.

Fires were cleaned one hour prior to starting all tests. Especial care was exercised to duplicate the conditions of the fuel bed at the beginning and end of all trials.

Tubes were blown every six hours during the 24 hour test.

The complete data for each test are given in Table III. In judging the performance results obtained, several important factors should be considered. The coal burned was not a high grade selected fuel but had a fairly high ash content and produced a troublesome clinker at high rates of combustion. The results as obtained with this fuel should therefore be considered as most creditable. The uniformity of the test conditions was materially affected by the variable operation of the three other boilers in service, all supplying steam to a common system. The limitation of capacity performance was entirely due to the inability of the stoker to handle and dispose of the troublesome clinker produced.

The data show that high overload capacities can be developed with this type of boiler and arrangement of baffles. The efficiency characteristic of the boiler and stoker is drawn in Fig. 2. The point corresponding to Test No. 3 is open to question, because the coal used contained more ash than the coal of the other tests. Since the resulting clinker interfered noticeably with the management of the fire at the high rating obtained, this may well account for the low efficiency of Test No. 3. The dotted curve probably represents the true characteristic of the boiler when burning coal of the quality used as long as it can be worked through the stoker. If the efficiency of Test No. 2 were raised slightly by alteration of the moisture content, as mentioned previously, it would agree closely with the dotted curve. The excess temperature of the gases from the boiler as affected by the rate of driving is given in Fig. 3. Fig. 4, shows that the boiler starting from a banked fire can take up a 300 per cent. overload in 4 minutes 23 seconds. From the excellent performance of this boiler at high overloads—overloads which were limited only by the fusing of the clinker in the low and fair grades of the coal used—it would appear advisable to consider the desirability of using larger grate areas than is customary.

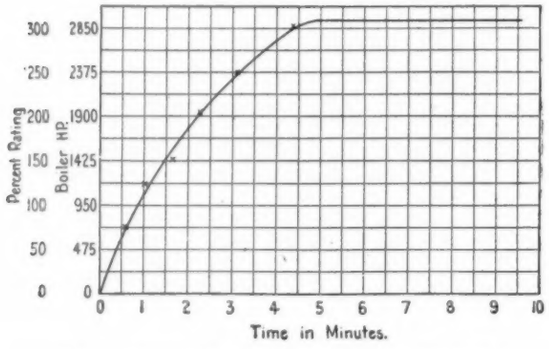

FIG. 3. CURVE SHOWING EXCESS TEMPERATURE OF GASES FROM STEAM BOILER AS AFFECTED BY RATE OF DRIVING.

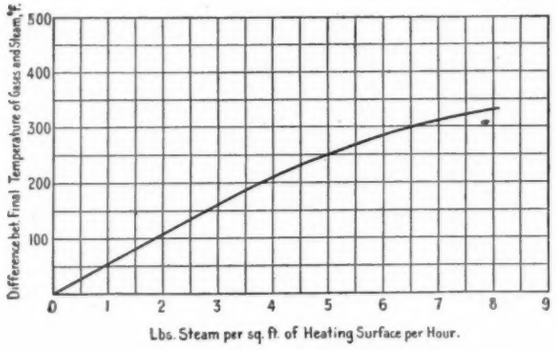
Difference bet Final Temperature of Gases and Steam, °F.
500
400
300
200
100
0 1 2 3 4 5 6 7 8 9
Lbs. Steam per sq. ft. of Heating Surface per Hour.

FIG. 4. CURVE SHOWING HOW RAPIDLY THE HEINE BOILER WILL TAKE UP A HEAVY OVERLOAD STARTING FROM A BANKED FIRE.

The results further establish that the arrangement of baffling which is especially suitable for obtaining maximum capacities does not affect adversely the efficiencies obtained at lower ratings. High overloads could have been readily maintained for indefinite periods if a higher grade fuel had been available.

The combustion results obtained were consistently good. The flue gas temperatures were not extreme considering the capacities developed. The condition of the heating surfaces after tests was found to be good with little accumulations of soot and with no deposits of slag.

CHLORINE MAKES BETTER SHOWING THAN OZONE AT MILWAUKEE.

Since ozone as a disinfecting agent for public water supplies has been used in Europe in a considerable number of municipal plants, some of which are of fair size, Mr. Joseph W. Ellms, Consulting Engineer, Cleveland, Ohio, in his experiments on the purification of the water supply of Milwaukee, Wis., decided to try the use of ozone as a disinfecting agent, and to make such necessary studies of its value and adaptability to Milwaukee conditions as time would permit.

It should be stated that the Milwaukee water supply has been chlorinated for some years and "the value of this process to Milwaukee has been very great when

measured by the reduction its use effected in deaths from intestinal diseases. It still remains the only barrier between consumers and epidemics of typhoid fever and other water borne diseases." Quoting further from Mr. Ellms' report, we have his recommendations on disinfection to follow the recommended filtration:

"That disinfection of the water after being filtered be practiced as a second line of defense against contamination; that chlorine be used for this purpose, and that the amount applied be approximately one-half that which was used on an average in treating the raw water supply of the City during 1919.

"That no attempt be made at the present time to employ ozone as a disinfecting agent for either the raw or filtered water, since the experimental evidence obtained indicated the apparatus had not been developed sufficiently to produce ozone at low enough cost to enable it to compete with chlorine as a disinfecting agent, and that the first cost of installation and the subsequent cost of operation and maintenance would be too high for use in a large municipal plant of the size required by Milwaukee."

PLANNING MOST SUCCESSFUL MUNICIPAL CONVENTION

The American Society for Municipal Improvements will hold its annual convention in St. Louis on October 11-15 of this year. This choice was made at the request of the St. Louis members, who were very anxious to secure this meeting, and who are making elaborate plans to entertain the convention. Recently a meeting of engineers, contractors, and others interested in municipal development was held, and six committees, involving a total membership of about forty, were formed. These were Committees on General Arrangements, on Finance, on Exhibits, on Entertainments, on Badges, and on Automobiles. The General Committee consists of Mr. S. Sammelman, Chairman, Messrs. E. R. Kinsey, C. M. Talbert, Nelson Cunliff, Harland Bartholomew, Edward E. Wall, Arthur L. O'Leary, Wm. Stoecker, W. E. Ferguson and W. W. Horner. The Society is represented by W. W. Horner, Vice-president, resident of St. Louis, and by Mr. C. C. Brown, Secretary, who made a special trip to St. Louis recently to attend a meeting of the committee.

Mayor Henry W. Kiel of St. Louis has sent out a general call to mayors and municipal officials all over the country to attend this meeting, and it is expected that special conferences will be arranged between mayors of cities of the same class. Mr. E. R. Kinsey, president of the Board of Public Service, has sent a similar invitation to a mailing list of over three thousand engineers.

St. Louis men are making a particular effort to make this the most successful meeting of municipal officials and engineers ever held. They feel a proprietary interest in the American Society for Municipal Improvements because of the presidency of the society having been held by a St. Louis man, Michael J. Murphy, for the first two years of the society's existence. It is also felt that the meeting in St. Louis is very apropos because of the large variety of municipal enterprises now under way in that city.

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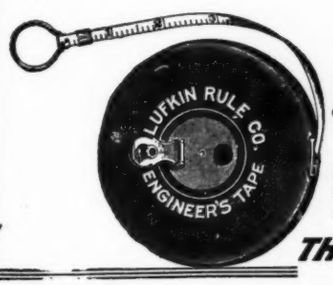

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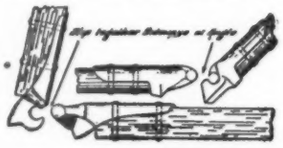

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CONSTRUCTION NEWS AND EQUIPMENT

DRAGLINE EXCAVATOR USED ECONOMICALLY IN BUILDING HIGHWAYS IN THE PLATTE VALLEY IN NEBRASKA

By George E. Johnson, Secretary, Nebraska Department of Public Works, State House, Lincoln, Neb.

One of the most interesting Federal and State Aid road projects now under construction in the State of Nebraska, is known as No. 27, and is located in Merrick and Nance Counties, and runs from Central city to Belgrade. The road is located in a particularly low and flat country, as it starts within three miles of the Platte River. At three times during the construction season this year, the road has been completely under water, so that from the standpoint of safety and economy, it was necessary to provide a road which would be in a good condition for travel the year around. In order to have such a road, it was found, after the preliminary survey, that the road would have to be raised from 2 to 3 ft. above the surrounding country. At the beginning of the season, the road was in fairly good condition for travel, though somewhat rough; especially was this true of the last two miles, near the end of the project. The soil is very sandy. Silver Creek crosses the road about 3½ miles north of the beginning of the road, and in order to build the road across Silver Creek bottom, which is very low and flat in contour, ditches were excavated on either side, and the material excavated was used to make the fill, and thereby raise the road to the necessary height.

Instead of using the usual elevator grader to make the cut, and the ten or more teams to haul the material, a drag-line excavator, with a capacity of 1 yd. was purchased. At the present time the work is being done by a force consisting of a Superintendent and four men, two of whom operate the machine.

It can readily be seen that the saving of labor is no small item due to the method of handling the work. A project of this size generally calls for from 10 to 15 men, and equally as many teams, if not more. With the present method, the force is reduced considerably and no hauling is necessary. The advantages of the method of building a road of such a type, may be considered from an economical and time-saving standpoint. First, the contractor will experience few days of lost labor expenses, because of waiting for the low places on the road to dry up sufficiently after a rain. The excavating machine can work irrespective of weather conditions. Second, all material within the right-of-way can be utilized for fill, notwithstanding the obstructions such as telephones, etc., which are often found in the way. With two men operating the machine, 500 cu. yds. of earth can be excavated with an uninterrupted run of ten hours. Third, the work is taken out to exact sections, called for by the plans; however the fills contain excess materials.

It is naturally to be expected that it will take some time for the fills to compact, and there will be considerable finishing necessary before a good compact roadway will result. But, in spite of the drawbacks, the method has merit. Constructing earth roads is proving very successful and economical by this method, and will solve the problem that has bothered many State Highway Departments for some time, and it will be especially useful in building roads in the Platte Valley, where the finished grade must be raised from 2 to 3 ft. higher than the surrounding country. The conditions have been such that heretofore, it has been impossible to borrow dirt with an elevating grader to any great depth on the side of the road.

P. & H. DRAGLINE EXCAVATOR USED ON ROAD GRADING IN NEBRASKA.

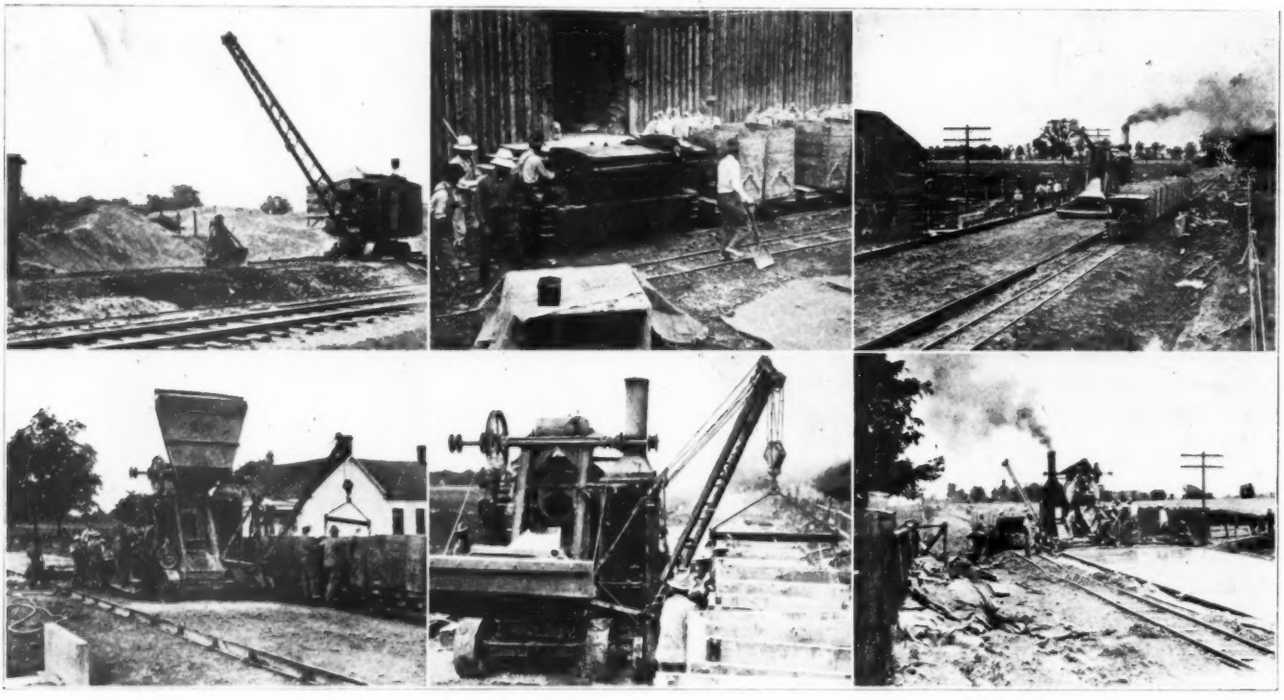
View of the 1 cu. yd. Dragline Excavator used in Road Building in Platte River Valley, where it is impossible to borrow dirt with an Elevating Grader—Another View of the Dragline. Water lies along the Roadsides which are very flat and low—Rough Fills made by Dragline must stand for Many Days before they are Finished and Shaped.

Printed as insert to Municipal and County Engineering, Chicago, Ill., August, 1920.

NEW RECORD MADE ON CONCRETE ROAD CONSTRUCTION NEAR PARIS, ILL.

A new world's record was established by Alan Jay Parrish, the prominent Illinois Highway Contractor, on June 30, 1920, when, with a 21-E Smith Simplex Paving Mixer, he laid 744 lin. ft. of concrete road, 16 feet wide, 8 inches thick, on a million and a half dollar contract near Paris, Ill.

This remarkable run was made in 9½ hours, using a four bag batch and allowing a full minute mix on each batch. The average time, throughout the entire day, for mixing and placing each batch, was just 75 seconds. The complete cycle of mixing operation ran from 70 to 72 seconds. Considering the fact that a full minute of mixing was required, this allowed 10 to 12 seconds for the loading and placing operation—the speediest average yet recorded on a complete day's run.



CONSTRUCTION EQUIPMENT USED ON CONCRETE ROAD CONSTRUCTION NEAR PARIS, ILL., WHERE A NEW RECORD HAS RECENTLY BEEN MADE

Action of the Paving Mixer

The factors contributing to this new record are worthy of study. The action of the paving mixer, as the principal factor, was primarily responsible for this accomplishment, although many other conditions contributed to the good work. The operations of the paver have been so synchronized that the discharging time and the skip-raising time were perfectly balanced. When the operator pulled the discharge lever, he would also engage the skip-raising lever. Thus the drum was completely emptied by the time the loaded skip, fully raised, began to reload the drum for the next mix. This perfect synchronism of operation, together with the brainy co-ordination of the supply crew, made it possible to maintain this record-breaking speed. No time was wasted. A second after the mixed batch was discharged, the material for the next batch was sliding into the drum of the paver.

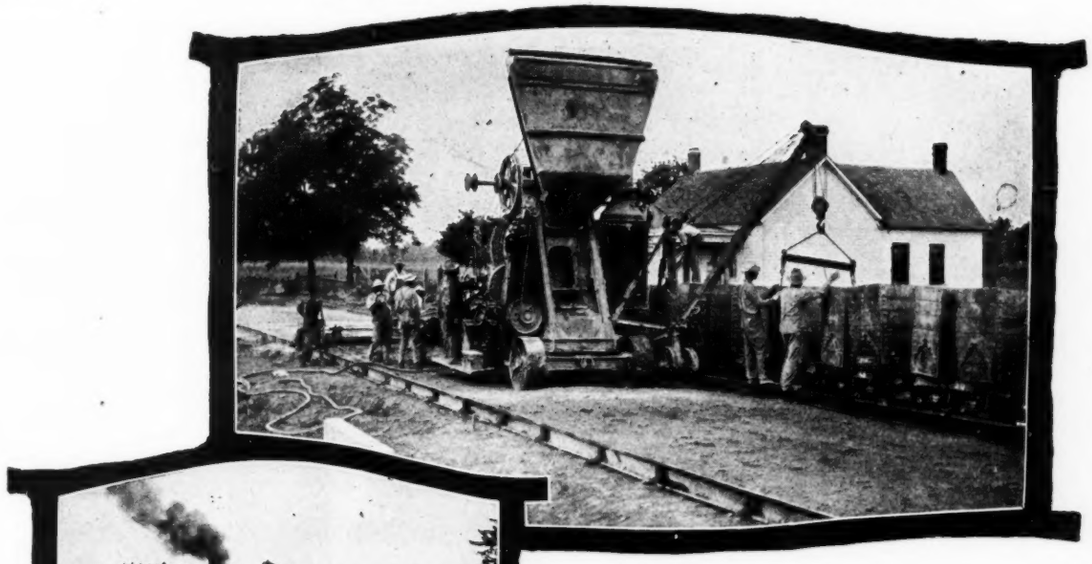
In loading the skip with the aggregate from the "turn-over" batch boxes, the time agreement in the movements of the skip and the derrick helped materially in avoiding unnecessary loss of any time. The movements of the derrick with which this paver is equipped are controlled by the movements of the skip. The derrick cable works over a drum on the skip-hoisting so that, as the loaded skip is raised, the derrick-hooks lower. When the skip is completely raised, the derrick-hooks are fastened to the loaded batch box, then as the skip lowers, the derrick cable rises, lifting the loaded batch box to just the proper height by the time the skip has reached the ground. Two men swing the batch box into position and dump its contents into the skip. Then the skip is raised and the derrick- hooks lower away the empty batch box to its car on the industrial train. During the minute of mixing, there is ample time to spot the batch box cars in position for the derrick to grab the next loaded box.

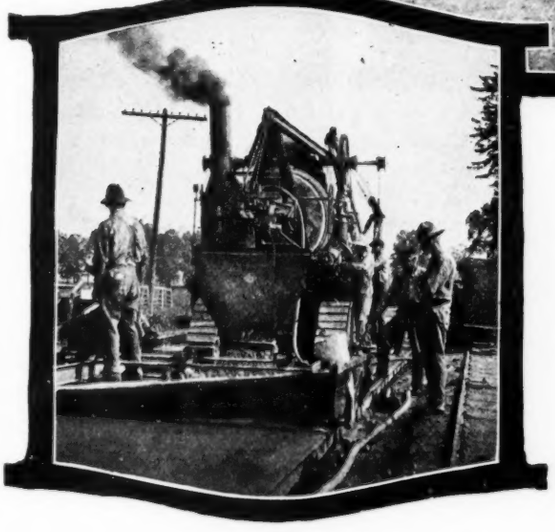
To appreciate fully how this 744 foot record was made, it is well to study other details of the job besides that part played by the paver itself. Starting with the arrangement of the material yards, everything was carefully arranged for speed.

The Industrial Railway

The yards are located at Oliver, Illinois, slightly more than a mile from the road Mr. Parrish is constructing. The sand and stone are unloaded from the cars by a ½ yard, full revolving Erie Crane, operating on a track parallel to the unloading siding. The crane deposits the material in huge material piles alongside the 24 in. industrial railway loading track. The same crane is used for filling the storage bins which make possible the speedy measuring and loading of accurate amounts of sand and stone for each batch box.

The industrial cars, each with two batch boxes, start at





744 Feet in One Day!

16 Foot, 8 Inch Road Paved by Smith Simplex Paving Mixer

This is the World's Record

IT is essential that you know just how Alan Jay Parrish, the prominent Illinois Highway Contractor, broke all records for speed in concrete road building. Just write—or wire—we'll gladly tell you, in detail.

With his 21-E Smith Simplex Paving Mixer, on June 30th, Mr. Parrish laid 744 lineal feet of concrete road, 16 feet wide, 8 inches thick. Such a record on a 16 foot road has never before been even ***approached.*** Still, Mr. Parrish says he will better that record before the job is completed.

Find out about the Smith Simplex—it is the most valuable Paver in the world!

Smith Pumps

supplied the water on this job. You should know the complete line of Smith Pumping Units. The Smith Excavator and Loader is a big labor saver, too. Ask for complete information on the Smith Line. All Smith Equipment represents ***Value that Endures.***

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Smith Simplex Paving Mixers
Smith Tilting and Non-Tilting Mixers
Smith Excavator and Loader
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STANDARDIZE ON SMITH EQUIPMENT

the loading bins, where the proper proportions of sand and stone are loaded. A hump has been built in the track at the loading bins so that the train then moves by gravity to the cement loading platform, where the cement is added to each batch box. Plymouth 3-ton locomotives then haul the trains to the paver. There is no back-switching after the trains once start through the loading process; they travel continuously toward the job. That helps eliminate waste of time.

Each locomotive handles 10 cars, carrying 20 batches. At no time during the day was there any delay in waiting for the next train to pull into position. A train was always ready on the siding. During the 9½ hours that the paver ran, 22 train loads, carrying 440 batches, were used. The mixture was a four bag batch of 1-2-3½ proportion.

An important detail that was handled in a particularly careful manner was the method in which Mr. Parrish prepared the grade for his industrial railway system. He has found from experience that a carelessly formed grade may eventually cause expensive trouble through derailments and delays. So this grade was built up properly and thoroughly drained before any steel was placed upon it. The result has been worth while; in laying over a mile and a half, so far, on this contract, he has had only two minor derailments.

The placing of the railway sidings was carefully planned so that it would be always possible to have the train load of batch boxes at the paver just when the material was needed. This eliminated the danger of the paver having to stand idle while awaiting the aggregate.

After completing a mile and a half of the pavement, the paver was moved back to the starting point and reversed, to work in the opposite direction. This reduced the length of the haul from the original loading station. Ordinarily this change would necessitate the shifting of the industrial car track to the opposite side of the road, within reach of the derrick. Due to the fact, however, that the derrick with which this paver was equipped is interchangeable to either side of the paver, the track was left on the same side of the road. The only change required was to move the derrick to the other side of the paver.

Heltzel Forms and Parrish Tamping Machine

The latest model of Heltzel Steel Forms were used and the tamping and finishing was handled in a very efficient manner by the new Parrish Tamping Machine.

Organization of Crew

It is particularly interesting to find that in breaking all records with this 744 lineal footage, a new low record was also probably established in the cost of the entire work. Although the exact figures are not available, it is a fact that the economies effected by the various labor saving devices were remarkable. To accomplish this big job with only 32 men, including every man on the job, from superintendent down to the water-boy, is a real achievement. The crew consisted of the following:

2 Crane men.
4 Men loading batch boxes—stone, sand and cement.
4 Train men.
8 Grading crew men.
2 Men ahead of Paver, handling batch boxes.
1 Engineer.
1 Fireman.
3 Men spreading concrete behind machine.
1 Tamping machine operator.
2 Men spading and edging.
1 Superintendent.
2 Foremen.
1 Waterboy.
Total number in crew, 32 men.

SANITATION OF ROAD CONSTRUCTION CAMPS

By John N. Edy, Chief Engineer, State Highway Commission of Montana, Helena, Mont.

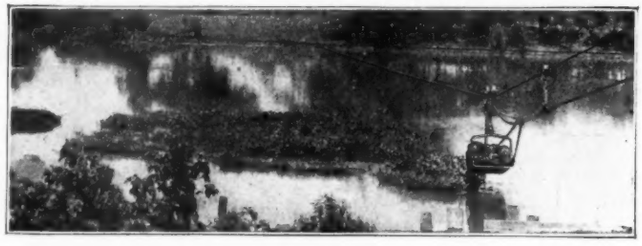
This subject will be discussed very briefly and from the standpoint of the relatively small camp such as might be maintained by the average road contractor operating in the state.

As I view the subject it quite logically subdivides into two principal divisions: First, Camp Accommodations and, second, Camp Regulations. In other words a camp is maintained in a sanitary state by providing the necessary accommodations and by enforcing regulations designed to keep it so. Here, as in so many others of life's relationships, there is the opportunity for the mutal advantage of close and sincere co-operation between the parties most interested.

Camp Accommodations

It seems hardly necessary to detail those camp accommodations that make for the safe and healthy habitation of men engaged in useful work. That the camp is usually but a temporary domicile does not in the least lessen the

MATERIAL-HANDLING SIMPLIFIED



THERE is a growing appreciation among engineers and contractors of the fact that the dragline cableway excavator method, so universally employed by commercial gravel-handling plants, can be utilized for other work involving excavating and moving materials over distances of from 100 to 800 feet or more.

The ability of the Sauerman Dragline Cableway Excavator to dig from either above or below water, and to elevate and convey materials from pit to plant without the help of auxiliary machinery, is the reason for its popularity among sand and gravel producers. This same ability makes our type of equipment correspondingly economical and efficient for a wide variety of other material-handling operations, and it is now being successfully used for cleaning reservoirs, building levees, rehandling coal, deepening rivers, reclaiming material from stock piles, loading ballast, etc., etc.

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P & H Excavator-Crane Excavating a Ditch and Grading a Road.

Road Builders' Combination Machine for Excavating, Grading, Backfilling and Material Handling

The P & H Excavator-Crane is a successful answer to the problem long recognized by contractors and manufacturers of producing one piece of equipment capable of performing the four general functions of Excavating, Grading, Backfilling and Material Handling. The four major uses of this equipment by road builders are as follows:

Grading Roads. Where road beds are low and need "shouldering up," or where fill must be made through water-logged and swampy land, the P & H Excavator-Crane will pull in and heap up the ground much faster and cheaper than will teams and graders.

Making Cuts. The P & H will make cuts in roads at the rate of 300 to 500 yards per day. The average cost seldom exceeds $20.00 for a day's operation. When the excavated material is loaded in wagons, the capacity is reduced only about 10 per cent. For constructing drainage ditches the P & H is run alongside or center of the completed road, excavating the ditches to the required depth and wasting the dirt on the slope of the road bed or beyond the ditch. On this operation the machine cost is rarely over 8 cents per yard, even when handling wet earth where it is often impossible to work teams.

Excavating Gravel. Capacity (approximate) 300 to 500 yards per day of gravel from the bank into trucks and wagons. The hauling equipment, working with a P & H, is never in the excavated hole as it is with steam shovel or trap loading. The P & H Excavator-Crane has a full circle, non-obstructed swing with an operating radius of 30 feet.

A Complete Portable Locomotive Crane. Equipped with a hook, magnet or other grappling device, the P & H is a complete portable locomotive crane with a lifting capacity of 3,500 pounds at 30-foot radius. Great for cleaning up a yard, placing pipe in trenches, pulling piles, moving the bulky stuff, loading and unloading cars. Remember the P & H has a full circle swing and is entirely self-contained, ready to operate on any spot without propping or stabilizing of any kind; worth its cost for this ability alone.

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"You see them wherever you go, and they go wherever you see them."

P&H — excavators — back-fillers - tampers

necessity and desirability for the application of the recognized principles of sanitation; it does, however, intensify the problem in that the plan of sanitation must be reasonably inexpensive as well as sufficiently effective. Considering this phase of the subject hurriedly we may assume that in a comfortable and sanitary camp there must be:

1. Good wholesome food.
2. Palatable and safe drinking water.
3. Clean and comfortable sleeping, dining and lounging quarters.
4. Prompt and continuous disposal of kitchen wastes.
5. Adequate and comfortable toilet facilities, including bath accommodation.
6. Proper segregation of all stables and out buildings.
7. Reasonable fire protection.
8. First Aid Service.

Other desirable features might be suggested, but these seem to represent or include practically all the essentials.

Fundamentally, men who work must eat. And if they are to work well and usefully they must eat substantial, well cooked food, served in a clean appetizing manner. This means a careful selection of foods; a thoughtful composition of menus and the most careful preparation and appetizing service of the meal by competent persons of cleanly habits and appearance. It means that during summer months the kitchen and dining room (or tents) must be screened because flies must be excluded: (I prefer the exclusion of flies to entrapping them on fly paper on in small pans filled with fly poison. Even if a dead fly is harmless, a sticky mass of dead flies can hardly be said to be "appetizing.") Our first requirement means also that uncooked food will be properly stored, always free from contamination due to any cause whatever, including our two camp enemies, flies and rats. "Good, wholesome food" then, means, in substance, that those persons attached to the camp will be permitted to enjoy their meals as well as to be nourished and sustained by them.

Of course water may be either safe and not palatable, or palatable and not safe—and the latter is not infrequently the case. The water supply would seem to be the most potential source of danger and should be adequately protected from contamination. While perhaps the ordinary mountain stream represents a safe supply, there is no assurance that such is the case. Certainly water from the ordinary irrigation canal should be viewed with suspicion. As a matter of fact it would seem to be but sensible, and the exercise of every-day caution, to have the water examined and tested by a competent person before approving its use. And then, as above suggested, the source of supply should be policed or otherwise insured and safeguarded. Water taken from a creek or river should be procured well up-stream from the main camp, and the immediate vicinity not used for any other purpose. If conditions justify, the water may be boiled or otherwise treated to increase its degree of purity.

But men do not live by food and drink alone. They—and especially is this true of men who do hard manual work—must have restful beds and comfortable lounging and recreation quarters. It is not necessary that a bunk house be "dolled up" like a bridal suite of a metropolitan hotel. It is necessary, however, that the quarters be clean, cheerful, ample in size, well ventilated, well lighted, well heated when necessary, and equipped with clean and comfortable cots, bunks or beds provided with sufficient clean bedding. One would think it altogether unnecessary to refer to this feature of the camp; and yet in this state and in all states are altogether too many examples of the unsanitary, unhealthful and uncomfortable camp sleeping quarters. The bunk house should be cleaned regularly and the bedding aired and washed; in a camp of any size a camp tender should be provided. If screens add to the comfort of the men, they should be provided. And I have in mind one accommodation that is very rarely provided: I refer to the construction of cheap gravel cinder or plank walks that permit the men to pass to and from the several camp units without tracking dirt, mud and filth into the quarters.

All kitchen wastes should be deposited in covered garbage cans and removed and disposed of sufficiently far from the camp area. Cheap incinerators may be provided for burning the refuse, or it may be buried. I have spent some time in and about construction camps, and have never been quite convinced of the necessity or desirability of maintaining a hog ranch as a means of camp garbage disposal. I regard it as unfortunate but it seems to be none the less true that most camp cooks either own or very speedily acquire one or more squealing pigs which they proceed to develop on camp garbage. If a pig sty must go with the camp, it should be located not closer than the adjoining county.

Camp facilities for receiving and disposing of bodily wastes are usually crude and unsanitary when very little additional expense would provide proper and safe accommodations. The danger here is from flies and the contamination of drinking water. A reasonable care and thought in laying out the camp site will permit an arrangement of out buildings that will be both safe and sanitary. Disinfectants should be used freely and frequently and the exterior premises maintained in a neat and clean condition.

Most men desire to bathe but those who are not so inclined should be required to observe the usual rules of bodily cleanliness. Bathing accommodations must be provided and used.

Needless to say, stables and similar units should be properly segregated and cleaned. Stable waste must not be permitted to accumulate, but must be removed regularly.

Reasonable fire protection may be provided in several ways, one of which involves the erection of a modest and inexpensive water tank that may be filled by pumping and with which is a sufficient length of hose to reach the principal units of the camp. Fire protection may not be thought to be an essential of sanitation. But the tank and hose may be used to advantage for laying the dust by sprinkling.

First Aid service is essential; particularly in camps far removed from medical practitioners. In large camps a physician may be retained to make frequent physical examinations of the men, and to advise in matters of general sanitation.

Nothing has been said of laundry facilities, although it would seem that this matter is important and must certainly have the attenion of the camp proprietor.

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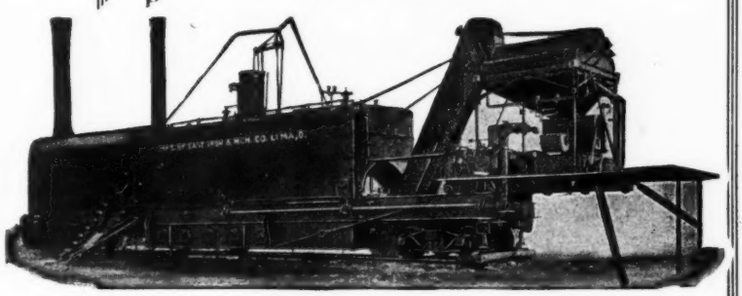

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Trouble in the pipe line between the melting tanks and weight bucket is eliminated.

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Patented **Steam Heat** Melting!

Guaranteed capacities!

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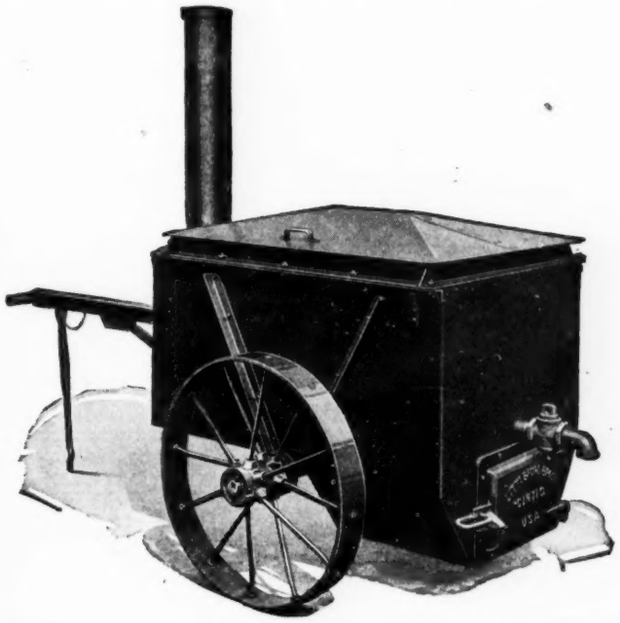

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CINCINNATI, OHIO

Camp Regulations

And now, briefly, what of the other divisions of the subject, that relating to camp regulations? Simply this: that as long as men are human they will at times become careless. Few men are naturally or habitually unclean; but many men are thoughtless and not a few are ignorant of the most elementary health rules. A camp can be kept sanitary only by the most rigid enforcement of regulations covering the requirements of the case. Typewritten copies of these regulations should be placed conspicuously in every unit of the camp, and as new men enter the camp they should be informed as to the text and significance of the sanitary regulations. Experienced and wise contractors will discharge an employe more readily for violating the camp rules of sanitation and conduct than for failing to perform the manual task assigned him.

The foregoing paper by Mr. Edy was presented at the recent annual convention of the Montana Public Health Association.

SMITH PAVER HAS SCIENTIFIC FRAME

An authority on road construction recently remarked that fully 90% of the paver breakdowns were due directly or indirectly to the frame. The frame is the foundation—if it fails to stand all of the terrific strains imposed upon it, some other vital part will probably drop out of alignment and soon the contractor is tied up with a broken paver and an idle gang.

FRAME OF THE SMITH PAVER

Realizing the great importance of this feature, the engineers in designing the Smith Simplex Paving Mixer have built into it unusual strength. Ordinarily it might not appear as though such great strength is necessary until some important facts in connection with the operation of a paver are considered. On a boom and bucket machine having a capacity of 21 cu. ft. of mixed material, the tension on the rope that supports the boom is 8½ tons. This pull creates a thrust on the boom toward the machine and against the bottom of the frame of over 10 tons. Add to this the strain of a cubic yard of stone, sand and cement being constantly lifted up and thrown down in the revolving drum; the weight of all the necessary machinery, engine, boiler, etc., and it becomes obvious why particular attention should be paid to the construction of the frame.

The frames of the 14-E and 21-E Smith Pavers are made of *double channels* combined into a single pillar of strength by ¼-in. steel gusset plates, all hot riveted. This construction gives a strength 12 times as great as single channels and six times as great as two channels separately. On the 10-E where the stresses are much less, the construction is the same except that angles instead of channels are used.

This studied construction is valuable to the contractor because it gives him added years of service out of his paver, and at present prices this is a feature that the contractor must look for.

CONSTRUCTION PLANT ON IOWA ROAD JOBS

The Floyd county, Iowa, concrete paving project is making rapid progress. The Gravey Weinberg Construction company officials as soon as they were awarded the contract on May 18 went home, packed up their outfits and were on the job laying out their plant and getting ready for actual work almost before the contract signatures were dry on the paper. A train of beer refrigerator cars, put out of business by the "dry" laws, was leased from a Milwaukee brewing concern and put to hauling cement instead of beer. Daily these cars make their trips from Charles City to the cement manufacturing plants at Mason City and came back loaded with road building materials instead of "booze." This company's outfit is going strong; they have laid 550 ft. in 12 hours several times and most of the time are able to put down 50 lineal feet per hour, reports the Iowa Highway Commission Service Bulletin. A central proportioning plant has been established at the Floyd crossing and Ford trucks with Lee bodies holding four bag batches carry the material on an average haul of three miles to the mixer. A second mixer is ready for installing on the job. The contractors plan to have the eight mile section completed by September 1.

Henry Horst, the Illinois contractor, on the five mile stretch at the Clear Lake end of the Mason City-Clear Lake road to the county line is making good progress. He is using a central mixing plant with Ford trucks and Lee bodies hauling a 4-bag batch an average of about two miles. Mr. Horst by a system of bonuses is speeding transportation to the maximum. The truck drivers have entered into the contest with spirit and the race is on to such an extent that the contractor declares he is likely to go broke paying bonuses. So far he has had good success in delivering the wet mixed batch on the job in perfect condition for the placing on the road.

O'Neil & Sons and the Hinkle Construction company, the other Cerro Gordo county contractors, are installing Industrial rail equipment on each of their jobs. The tunnel method of loading has been adopted in which the material is stored in large elevated bins under which the cars are run and the material dumped into them by means of levers.

The Raymond Wright company has started pouring concrete on the Des Moines Ankeny road in Polk county. They are using a centrol proportioning plant stationed at the county farm and hauling the mixed materials in trucks, equipped with Lee bodies. A portion of these trucks carry two of the Lee bodies each with its batch of material doubling the transportation value of the truck.

CONTRACTS AWARDED

ROADS AND STREETS.

Ark., Conway—Oliver Constr. Co. awarded contract by Faulkner Co. Commrs. Conway and Damascus, Conway and Vilonia & Conway and Palarm Rd. Impvt. Dists., for constr. of 54 miles hard surfaced road, 14 ft. wide; steel brdgs., conc. piers, rein. flrs., conc. and corrug. iron culverts, headwalls of concrete, at $1,225,000.

Ark., Osceola—H. O. Hansen Constr. Co., Blytheville, Ark., awarded contract for road work in Miss. and Poinsett Co., att $1,250,000.

Cal., San Diego—D. H. Ryan, 1615 Fern st., San Diego, awarded contr. for paving with 1:2:4 conc., 5 ins. thick, Julian Rd. No. 3A, county hwy., 9.65 miles, at $225,368; Hunkin-Conkey Constr. Co., P. O. Box 436, Los Angeles, awarded contract for paving Mission Rd. No. 1A, same material, 7.75 miles, at $269,995; Geo. R. Daley, San Diego, awarded contr. for paving with same material Chula-Vista-Coronado Rd. No. 6, 7.5 miles, at $159,708; V. A. Olson, awarded contr. for improving La Jolla Blvd., at 80c cu. yd. for excav. and 27c sq. ft. for cement walks; T. C. Breitenstein, P. O. Box 316, Pasadena, awarded contr. for paving Pine, Witherby and Hortensia Sts. with concrete and oil top.

Cal., San Luis Obispo—Hunt-Waugh Constr. Co., 1847 W. 43rd St., Los Angeles, awarded contract for grading, draining and paving 11 miles Route 3, Sec. A, San Luis Obispo-Cambria Rd. 5-in. conc. at $171,625.

D. C., Washington—Cranford Paving Co. awarded contract to resurface 48,000 sq. yds. streets at $220,000.

Del., Wilmington—Diamond State Constr. Co. awarded contract for construction of Sec. 5-A, Lincoln Hwy., at $190,197, exclusive of brdgs. and culverts.

Fla., Okeechobee—J. E. Nash awarded contract for hard surfacing 101,000 sq. yds. streets; broken stone with bitum. surface, $200,000 available.

Ga., Savannah—Chatham County Commrs. let 923,610 contracts for Tybee road; Globe Dredg. Co. for embankments, at $265,000; Va. Bridg. & Iron Co., Roanoke, Va., $258,610 for brdgs.; Gadsden Contracting Co., $400,000, superstruct. and substruct. work, piers and flrs., etc.

Ind., Terre Haute—Carpenter Constr. Co. awarded contr. for impvt. of Dodd Rd., Secs. 1 and 2, at $142,505 and $121,369 respectively; C. F. Hill Rd. $120,680; Seidenbender Rd. $172,000; Premier Constr. Co., W. E. Eppert Rd. $204,000; Connery & Cline, brdg. on Lockport Rd. at $6,800.

Mass., Boston—Rowe Constr. Co., 45 Milk St., awarded contr. for paving Belgrade Ave., Beach and Center Sts, Topeka, at $303,398.

Minn., Duluth—A. N. Nelson, 1014 E. 6th St., Duluth, award. contr. for impvt. of Railroad St., 7th Ave. W. to Garfield Ave., at $104,456.

Minn., St. Paul—Fielding & Shepley, awarded contrs. for paving of Cleveland Ave., at $93,998, and paving streets in Macalester Park Dist. at $253,000.

Mont., Helena—Following contracts for road bldg. let by Executive Comm. of State Hwy. Comm.: Jas. O'Connor, Chinook, contr. for rebldg. roadway from Havre east to Hill county line, at $74,877; H. S. Lord Co., Missoula, contr. for bldg. bridges on project, at $22,714; White, Brown & Leahy, Great Falls, contr. for project No. 658, Cascade county end of Choteau-Sun river road, at $104,174.

N. J., Newark—M. J. O'Connell, Hackonsack, awarded contract for reconstruction of Kearney Ave., N. Arlington, at $170,000. Entire wk. will cover 30,000 sq. yds.

N. J., Freehold—Thompson & Glickman, Freehold, awarded contract for constr. of Freehold Adelphia Road at $82,159.

N. M., Santa Fe—A. P. Atchison, Raton, N. M., awarded contract for construction of F. A. Proj. No. 13-A, Valencia Co., which includes 10.859 miles graded and surfaced rd. complete with structures, betw. Armijo and Laguna, at $83,095, exclusive of 10% for engrg. and contingencies. Atlas Constr. Co., LaVeta, Colo., awarded contract for F. A. Proj. 24, Roosevelt Co., 11.356 miles graded and surfaced rd. complete with structures, betw. Clovis and Portales, at $97,183, exclusive of 10% for engrg. and contingencies; also contr. for F. A. P. 25, Curry Co., 15.437 miles graded & surfaced rd., etc., betw. Texico and Portales, via Clovis, at $91,252, exclusive of the 10% etc.; LaRoe and Burgess, Palestine, Tex., awarded contract for constr. of F. A. Proj. 18, Eddy Co., 32.411 mi. graded and necessary draing. structs., betw. Carlsbad and Lovington, at $80,949, exclusive of 10% etc.

N. M., Santa Fe—J. V. Stryker Constr. Co., Denver, Colo., awarded contr. for constr. of F. A. Proj. 32, San Miguel Co., which includes 15.084 mi. graded and surfaced road complete with structures, betw. Las Vegas and Mora, at $141,108.01, exclusive of 10% for engrg. and contingencies; also the contract for constr. of F. A. Proj. 33, Mora Co., which includes 12.706 miles graded and surfaced road complete with structs., betw. Mora and Las Vegas, at $176,269, exclusive of 10% etc.

N. Y., Long Island—Sicilian Asph. Paving Co., 41 Park Row, N. Y. City, awarded contr. for regulating and grading roadway, Jackson Ave.; also regulating and repaving outside r. r. franchise area, etc., at $195,838 and $198,838 respectively.

N. Y., New York—Cleveland Trinidad Paving Co., flushing, awarded contracts for paving and improving in railroad area when and where directed; also 72d st., at $173,400 and $17,309, respectively; Lexington Ave., 48th and 49th sts. to Sicilian Asph. Paving Co., 41 Park Row, at $18,226, $3,036 and $3,362, respectively; 54th st., to Asphalt Constr. Co., 2197 Madison Ave., at $11,075; 8th Ave., to J. L. Brusstar, Harlem river and 150th st., at $107,478; 2nd ave. to C. Helbroock, at $25,285; Church st., to W. J. Fitzgerald, 547 W. 45th st., at $50,181.

N. Y., Olean—Forness & Fote Co., Olean, awarded contract by commr. pub. wks. for 20,390 ft. brk. pavement on Front st., Garden ave., 5th ave. & School st.; also conc. brdg. 12 ft. span and 50 ft. long, at $110,207.15.

N. C., Clinton—P. Ashby, Raleigh, N. C., awarded contract to constr. 27.4 miles topsoil rd., with bridges, at $295,000.

N. C., Salisbury—R. M. Hudson Co., awarded contract to improve streets here with Bitulithic pavement, at $175,000.

O., Columbus—Franklin Asphalt Paving Co., awarded contr. for paving W. Broad st., corp. line to Big Four R. R. tracks, at $153,226.

O., Columbus—Foster Haffner Co., Dayton, awarded contr. for paving Ashland and Wooster Rd., Sec. B, end of present brk. paving east of Spook Hollow to Wayne county line, at $175,000.

O., Cuyahoga Falls—Columbus Asphalt Paving Co., Akron, O., awarded contract by council for 13,800 sq. yds. asphalt paving on Chestnut st., 7th to State rd., work includes paving, san. and storm sewers, water mains and service connections, at $141,808. C. E. McKahan, city engr.

O., Fremont—Modern Constr. Co., Fremont, awarded contract for constr. of 6½ miles of paving betw. Hessville and Woodville on Fremont-Perrysburg state highway, at $425,512.

Okla., Enid—Carl N. Hyde Constr. Co., Enid, awarded contract to construct concrete road; F. A. Proj. 24, at $262,185.

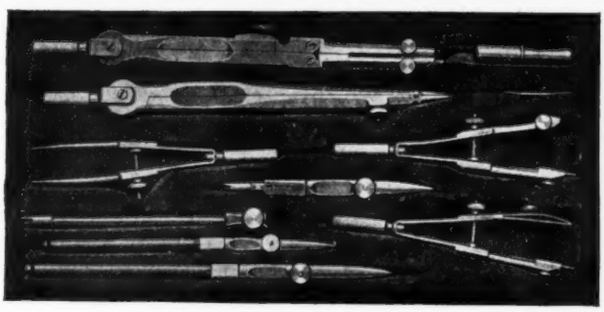
Pa., Phila.—Barber Asphalt Co., awarded contract for repaving Ridge ave., Lamonte st. to county line, at $134,000; Eastern Paving Co., awarded contract for paving Belfield ave., Wister to Penn., at $25,900.

S. D., Pierre—State Hwy. Comn. Pierre, let contract for grading and draining 24.46 miles Britton-Sisseton hwy. F. A. proj 41, Marshall & Roberts Cos., to Jahnig & Davis, Britton, at $215,107; graveling, also grading and draining 28.07 miles Aberdeen-Webster rd. and Yellowstone trail. F. A. proj. 22, Day Co., to commrs. Day Co., Webster, at $59,166 and $177,602, respectively.

Tex., Eastland—W. L. Fleming and F. E. Stitzer, awarded contract to construct 150 miles hard surfaced roads in Eastland Co., at $4,234,561.61. Bonds to amount of $4,500,000 have been voted and these will be taken by the contractors.

Tenn., Jamestown—Putnam Constr. Co., Cookeville, Tenn., awarded contract to construct 14,322 miles state hwy., No. 8, waterbound macadam, at $312,875.

Tex., Mt. Pleasant—Smith Bros. awarded contract by Titus Co. commrs. to gravel



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Tenn., Pulaski—Columbia Constr. Co., Columbia, Tenn., awarded contract; also Clayton Paving Co., Nashville, contract for construction of 19,086 mi. Bee-Line hwy, state hwy 32, rock asphalt surface, $569,989 available.

Tex., St. Augustine—H. F. Bland, awarded contract for grading 20 mi. road, district No. 3, San Augustine Co., at $114,-985.

Tex., Stephensville—O'Connor and Gilkison, Campbell House, Dallas, awarded contract for grading, graveling, bldg. draining, structs. on 31 mi. state hwy., No. 101 Erath Co., at $269,966.

Utah, Provo—Gray & Murdock, awarded contract for improvement of strip of road leading from Provo to Lake View, at $64,-771; also contract for 3 miles leading from Pleasant Grove to Vineyard, at $86,194. Road will be of 7 1-2 in. concrete; the 1½ mi. concrete paving thru Lehi awarded to Wattis & Samuels, at $39,959; also 1.7 mi. west thru Spanish Fork, at $49,000. Both firms located in Salt Lake City.

Utah, Salt Lake City—Reynolds-Ely Co., Salt Lake Co., awarded contract for surfacing and grading 30.53 miles Price-Emery hwy., 20 ft. wide, at $231,501.

Va., Richmond—Following contracts let by state hwy. dept., Richmond: Battershill & Clay, contract for 2.99 mi. bitum. macad. rd., betw. Danville and N. C. line, Pittsylvania Co., route 14, proj. 83, at about $75,409; A. W. McClay, contract for 4.23 mi. penetration macadam, betw. Harvey's store and Lawyer's. Campbell Co., route 14, proj. 70, at about $123,923; Allport Constr. Co., 5.03 mi. conc. rd., betw. Franklin and Courtland, Southampton Co., route 5, projs. 20A and 106, at approximately $200,-225. All contractors located in Richmond. Following work will be done by force account bids having been rejected; construction of ½ mile bitum. macad. rd. betw. Danville and Southern R. R., Pittsylvania Co., route 12, proj. S-48, approximate total cost, $22,998; 1.6 mi. bitum. macad. rd., betw. Front Royal and Riverton, Warren Co., route 7, proj. 63, approximate total cost, $46,637, G. P. Coleman, commr.

Va., Rustberg—A. W. McClay, Richmond, road betw. Lawyers and Salem turnpike, Campbell Co., at $100,000.

Wash., Spokane—General .Constr. .Co., awarded contract for 10 miles of hwy. near St. Maries, Benewah Co., Idaho, at $208,-000.

Wis., Superior—Peterson & Nelson, 1201 13th st., awarded contract for paving 6 miles Grand Ave., city limits to Spaulding ave., 18 ft. wide, concrete, at about $264,-000.

Wash., Aberdeen—C. E. Johnson awarded contract for work on East Hoquiam perm. hwy. No. 21; work on Gray's Harbor, Pacific Co. road No. 20, to August Wallin, at $78,000.

Wash., Bellingham—C. Sauset, city, awarded contract for 1,225 cu. yds. grading 2,580 sq. yds. conc. paving and other incidentals, at $10,307; also contract for 13,-000 cu. yds. grading, 75 B. M. lbr., 45,000 sq. ft. conc. walks, 16,000 sq. yds. conc. pavement, etc., on Cornwall ave., at $72,-922.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Los Angeles—Jno. Sutalo, 476 Camulos st., awarded contract for construction of cement pipe sewer in Hoover st., Florence ave. to 76th st., in the Hoover st. and Florence ave. sewer district; Martin Simunovich, 2705 W. 66th st. (Box 586, R. D. No. 1, Inglewood), awarded contract for constructing cement pipe sewer in Ocean ave., Altoona to Bayonne pl., at the harbor, at $53,723.

Colo., Fort Collins—Martin Johnson & Co., Boulder, awarded contract by commrs. for material; clay pipe to 27 in.; rein. lock joint conc. pipe above 27 in., at $102,345. Work must be completed this year. W. B. Cheek, city engr. Work consists of 25,634 cu. yds. earth excav. 35 manholes, 18 catchbasins, 145 inlets to sewers, rein. conc. pipe segm. blk., etc., etc.

Ct., Hartford—F. A. Barone & Co., awarded contract for construction of sewers on Wehasset st. and Stonington, Lisbon and Groton sts., at $14,086.

Ga., Winder City—Passmore-Davis Construction Co., Ga. Casualty bldg., Macon, Ga., awarded contract to construct ½-mi. san. sewers; 6-in. pavement; 7,000 ft. curb; $100,000 available.

Ia., Davenport—National Construction Co., Davenport, awarded contract for construction of $500,000 sewer system at Fort Madison. Work of laying new sewers, erecting pumping and ejector plants and overhauling present system will start latter part of July. Contract calls for laying 26 miles main and lat. sewers, composed of both 8 and 24-in. pipe; two separate ejector plants will be erected at each end of city.

Ia., Fort Madison—National Construction Co., Davenport, awarded contract for furnishing and laying 26 miles 8-24 inch san. sewer pipe; also bldg. pumping stations, etc., at $487,248.

Ia., Nevada—P. K. Mathism, Nevada, Ia., awarded contract for constr. of Indian Creek twp. draining dist. No. 99, at $7,000; National Sewer Pipe Co., Webster City, Ia., for tile, at $14,850.

Mich., Detroit—R. D. Baker, Detroit, awarded contract for construction of Fenkell ave. arms, at $80,995 and lateral arm in Monica ave., at $11,400.

Mich., Detroit—City let contract for labor and material for bldg. brk. conc. vitr. or conc. segmental blk. sewer in Linwood ave., sec. 4, involving 2,587 ft., 2-ft., 9-in.-5 ft. 3-in. cyclinder to Jeynes and Affield, 1208 Ford bldg., at $68,700; Alter rd. pub. sewer (uncompleted portion), 1,755 ft. 5 ft. 6-in. cylinder, laterals 3114 and 3173 to W. Blanck & Co., 827 Ford bldg., $49,624, $3,-996 and $26,350, respectively.

Mich., Ironwood—W. S. Peters, Wakefield, awarded contract for laying 3 miles of sewer; 16,000 lin. ft. 12-in. to 24-in. sewer pipe, at $43,000.

Minn., St. Paul—Thornton Bros. Co., awarded contract for constructing sewers on Hubbard st.—Hamline ave., at $10,460.

Minn., Thief River Falls—Jackson Construction Co., Jackson, awarded contract for storm sewers, at $24,000.

Mo., El Dorado—Hybskmann & Wiley, Senica, awarded contract for construction of sewerage system here, at approximately $30,000.

Mo., Kansas City—Kinlen Construction Co. awarded contract to construct combination storm and sanitary sewer betw. 65th st. and Troost ave., at $31,329.

N. J., Haddonfield—W. Penn. Corson, Camden, awarded contract for erection of new sewage disposal plant in Westmont and for outfall sewer; also for improving and enlarging present disposal plant on Cooper creek. $113,000 appropriated for the work.

N. J., Newark—Harrison & Craig, 31 Clinton st., awarded contract for bldg. main sewer and branches in Roanoke ave., at $117,687.

N. D., Grafton—J. O'Connor Co., Fargo, awarded contract to build sewers and water mains in 25 blocks, at about $40,000.

O., Cleveland—Iafornaro & Co., awarded contract for constructing sewer in Superior ave., northeast, at $10,600.

O., Cuyahoga Falls—City Construction Co., Youngstown, O., awarded contract for north side sewer system. Work involves 5.840 ft. 15-in. pipe, 200 wye branches, at $22,467; Philip Agrias, Akron, awarded contract for West Broad st. lateral san. sewers, at $26,070. 7,600 ft. 8-in. pipe, 4,500 ft. 6-in. pipe. C. E. McKahan, city engr.

Pa., Phila.—Moss & Taylor, awarded contract by dept. pub. wks. for construction of branch sewer in 65th st., from Lansdowne to Lebanon ave., at $30,889.

Pa., Phila.—Following sewer contracts, totaling $90,000, awarded: Richard Bennis contract for branch sewer in Wayne ave., Westview ave. to Carpenter st., at $13,000, one in 20th st. and Limekiln pike, betw. Godfrey and Medary st., at $10,600; estimate of Richard Bennis, branch sewer, Marvine st., $12,000; Peter Ellis, Ruscomb st., at $11,500; W. H. Carson, Bucknell, $7,000; 68th, $31,000; McCool Construction Co., Almond st., $2,200.

Pa., Phila.—O'Neill Co. awarded contract for branch sewer in 4th st., Wyoming ave. to Annsbury st., at $58,000.

Tex., Farmersville—J. W. Crook, Parks, Tex., awarded contract to construct 40,000 ft. sanitary sewers, at $40,000, and disposal plants, $65,000.

Utah, Ogden—Wheelwright Construction Co., awarded contract for construction of main outfall sewer in district No. 134, at $957,614; also paving district No. 134 at $38,673.

Wis., Ashland—Jno. Sandstorm, awarded contract for construction of 36-in. sewer at $9 per ft., and 8-in. sewer at $3.40 per ft.; total contract price, $13,221, including 10 manholes.

Wis., Waterloo—Gray-Robinson Co., Manitowoc, awarded contract for san. sewers and appurts., at $62,306.

WATER SUPPLY AND PURIFICATION.

Cal., Los Alamitos—Thos. Haverty Co., 8th & Maple ave., Los Angeles, awarded contract for construction of 6 miles 30-in. exhaust pipe line from plant of Los Alamitos Sugar Co. to Pacific ocean. Pipe line will be both cement and cast iron. Contract price about $250,000.

Lower Cal., Mexicala—Pacific Pipe & Supply Co., Los Angeles, awarded contract for furnishing Cl. B cast iron pipe, 4 to 14 ins. and fittings at about $150,000; Pittsburg & Des Moines Steel Co., contract for elevated steel tank, including foundation and all work complete, at $21,300.

Cal., Monrovia—Western Pipe & Steel Co., Los Angeles, awarded contract for furnishing 2,600 ft. 8-in. No. 14 gauge, 1,400 ft. 14 gauge riveted steel pipe and fittings for city water system at $4,295. The Crane Co. awarded contract for furnishing 5,000 ft. stand. screw pipe, immediate del, at $4,366; Grinnel Co. awarded contract for 5,000 ft. 4-in. c. u. pipe, at $4,262; Chapman Valve Co., awarded contract for one 14-in., three 8-in., and eight 4-in. valves; Crane Co., contracts for two 14-in., three 6-in., and 17 4-in. gate valves.

Ill., Rockford—Security Bldg. Co., 17th st., awarded contract by city for bldg. 197x215 ft., concrete reservoir on Stanley and Cedar sts., at $122,732.

Mass., Boston—Two miles of subterranean piping for downtown high pressure fire service is provided for in contract awarded to C. & R. Construction Co., at $111,859. Plans call for total of nearly 15 miles of piping for entire pipe system.

Mich., Gross Pointe (Detroit P. O.)—T. Iglehart, 209 S. LaSalle st., Chicago, Ill., awarded contract for furnishing labor and material for trenching and laying 8,000 ft. 8-in. cast iron water pipe in Beaconsfield and Queen aves., to include valves, hydrants and specials, at about $25,000.

Mich., Ironwood—Jos. E. Nelson & Son, Chicago, awarded contract for pipe for water supply, at $60,525.

Mich., Ironwood—W. S. Peters, Wakefield, awarded contracts for installing new water works system here, at $50,230; also contract for erecting the bldgs., at $62,613; Lee Courtenay & Co., contract for pumping equipment, at $27,600 for proposition A and $28,800 for proposition B. More data will be secured before it is decided which proposition will be accepted; Lulow Valve Co., contract for valves, at $3,120, and Venturi Meters contract to Simplex Valve & Meter Co., Phila., at $1,065.

Mich., Muskegon—Wm. Bluhm, awarded contract for installing lateral sewers and water mains throughout the heights. Bid calls for 10% above cost of labor and materials as far as money provided by bond issue will go; A. R. Morrison, Port Huron, awarded contract for construction of new and separate unit to city's water works Following contracts let for water and gas mains: Chas. Eklund, 69th ave., W., from Grand to Canadian Northern tracks, at $2,-760; Norquist & Berg, Wylkins ave., Parkman to Silcox ave., $1,719; J. A. Johnson, 63rd ave., W., from Green to Pizarro st., 62nd to 63rd ave.

N. J., Bordentown—G. Feifer, 209 Market st., Camden, awarded contract for bldg. water supply system for industrial school here, at $22,500.

N. Y., Tonawanda—Roberts Filter Co., Darby, Pa., awarded contract by council for installing mechanical equipment in filtration plant, city pumping station; 6,000,-000 gallon plant, at $79,930.

O., Akron—Gangi Construction Co., 737 Second National Bank bldg., awarded contract for bldg. water works system, involving 19,800 cu. yds. earth and 200 cu. yds. rock excav., 25 cu. yds. concrete masonry, and 29,650 ft. 4-20 in. cast iron pipe, at $41,996.

O., Dover—Jos. K. Skeldon Engineering Co., Toledo, awarded contract for improvement of water works and light plant at about $100,000.

O., Xenia—Lloyd Contracting Co. awarded contract for building new filter plant for new water supply to be developed by city of Oldtown, at $20,000.

Okla., Madill—City has let following contracts for extension of water works; constructing pipe lines, $54,000; T. C. Brooks & Sons, Jackson, Miss.; erect 150,000-gal. elevated tank, $18,540, Chicago Bridge & Iron Works, Chicago, Ill.; install pumping

mach. & equipt., at $29,875, to Merkle Mach. Co.

Okla., Miami—A. R. Young Constructing Co., Little Rock, Ark., awarded contract for bldg. 1,000,000-gal. reservoir and extensions to water works system, at about $35,000 and $133,000, respectively.

S. D., Ravania — Bruce - Bickelhaupt, Yankton, awarded contract for water works system, at $17,450.

Tenn., Nashville—Worthington Pump Co., awarded contract for bldg. two 20,000-gal. high service pumps and two 20,000,000-gal. low service pumps, at $87,750 and $93,200, respectively.

Utah, Srem—J. L. Lyman awarded contract for installation of water mains in Provo canyon; R. C. Green, contract for laying city water mains, estimated cost of work, $110,000.

Wash., Fairfield—Standard Asphalt & Paving Co., Spokane, awarded contract for bldg. complete water works system, at $43,586.

Wash., Wenatchee—City has entered into contract with the California Filter Co. for construction and installation of complete 2,500,000-gal. filter plant at cost of approximately $53,000.

PROSPECTIVE WORK

ROADS AND STREETS.

Ariz., Holbrook—$150,000 road bond issue carried at special election. Roads to be improved are: Holbrook to Apache county line; Holbrook to Winslow, Winslow to Coconino county line; Holbrook south to Snowflake, and Holbrook north to Moqui reservation.

Cal., Blythe—City Engr. B. P. Sewall instructed by council to prepare plans and specifications for paving Hobsonway, the main business street betw. the east and west city limits. It is expected that proceedings will be instituted to pave Main st. and Broadway also.

Cal., El Centro—Imperial Co. Hwy. Comn. will receive bids in September for construction of about 40 miles of paving connecting all the important cities of the valley.

Cal., Los Angeles—County road dept. preparing plans and specifications for constructing cement curb, gutter and walks on Eastern ave., Gage to Record sts., R. D. 1, No. 167; also Eastern ave, Hazard to Record sts., R. D. 1, No. 170. Plans and specifications also being prepared for about ¼-mi. conc. paving on Doheny rd, Sunset rd. to Beverly hills. Ordinance adopted by council to improve Wall st., Santa Barbara ave. to San Pedro st., under Vrooman act. Work will include grading and paving with 4-in. conc. base and 1½-in Warrenite surface and cement curb. conc. gutter, rein. conc. culvt., and 13 vitr. pipe house connection sewers.

Cal., National City—Bonds voted to pave between 7 and 8 miles of streets here with conc. Work will start some time in September. C. B. Ireland, city engr.

Cal., Santa Ana—Engr. J. L. McBride instructed to prepare plans and specifications for improvement of Euclid ave., one mile and Broad st., betw. Lemon st. and state highway in third road district.

Cal., Santa Barbara—Plans and specifications for remaining stretches of Lompoc dist. hwys. to be built under the $400,000 bond issue, now being prepared in office of Co. Engr. Owen H. O'Neill under his personal supervision. Good prospect for selling bonds.

Colo., Denver—More than $50,000 will be expended in paving with concrete the alleys in two new improved districts to be established in Park Hill and E. Denver. W. B. Lowry, Mgr. of Impvts. & Parks.

Ga., Columbus—As result of state supreme court decision just returned, city now has available $230,000 for street paving.

Ill., Peoria—Board local improvements has approved proposed $65,000 paving project for the Meadows addition on N. Elizabeth street. Estimate provides for paving Broadway street three blocks north from W. Nebraska ave., and two blocks each on North, South and West Eleanor place. Paving on Loucks ave. is estimated at $7,712 and North st. job at $6,360.

Ind., Bluffton—City Engr. A. Ery, instructed to prepare plans and specifications for paving West Central ave. Petition filed for this improvement, asks that present pavement be removed and new paving be laid on old foundation. Sheet asphalt and asphalt blocks seem to be the desired materials.

La., Winnfield—Winn Parish police jury will construct roads; $1,000,000 road bonds voted.

Md., Hagerstown—Washington Co. commissioners considering construction of 3-mile road in Hedgeville dist. Kentucky rock asphalt. $63,000.

Mass., Holyoke—City contemplates improving mountain road to Easthampton, waterbound macadam, about $50,000. T. J. McCarthy, city engr.

Mass., Northampton—$86,000 bonds appropriated to improve Main, Leeds and Prospect sts., asphalt and concrete.

Mich., St. Joseph—Paving of Lake Shore drive within immediate future is a strong possibility. Providing the 5-year 5% hwy. bonds can be sold in St. Joseph, state will immediately draw new plans and specifications and call for bids for construction of an asph. conc. road on macad. base. Under proposed plan the drive will be paved from Winchester ave. south to city limits at width of 20 ft. Betw. Winchester and Hatch sts. it will be 30 ft.

Mo., St. Louis—Board of aldermen approve program of street work to cost $298,000.

Mont., Helena—With work under contract approximating $4,000,000 in cost the state hwy. comn. is exerting itself to add $1,000,000 additional to road projects in state this year. Richard S. Zahniser, asst. engr.

N. J., Haddonfield—Borough Bd. of Commrs. passed ordinance to appropriate $44,000 for water and sewer main extensions and for street paving. Improvements are to be confined to Woods farm, now under development, Sutton tract and paving E. Cottage ave.

N. Y., Brooklyn—Bd. of Est. has authorized following improvements: Regulating and grading and paving with asphalt Gleenwood rd., Brooklyn ave., to 38th st.,

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Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Bodies, Dump—Motor Truck.
Columbian Steel Tank Co.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Pawling and Harnischfeger.

Buckets, Grab.
Mead-Morrison Mfg. Co.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
American Cast Iron Pipe. Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Crane Co.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement, Portland.
Portland Cement Association.

Cement Testing.
Kirschbaum, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Centrifugal Pumps.
De Laval Steam Turbine Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The.

Concrete, Reinforcement.
American Steel & Wire Company
Truscon Steel Co.

Concrete Sewer Pipe.
De Smet Quartz Tile Co.

Concrete, Tanks.
Mensch, L. J.

Concrete Tile.
De Smet Quartz Tile Co.

Conduits.
Cannelton Sewer Pipe Co.
Philip Carey Co., The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
City Wastes Disposal Co.
Dow & Smith
Flood, Walter H., & Co.
Samuel A. Greeley
Howard, J. W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander
Shields, W. S.
Van Trump, Isaac.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The.

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Crushed Stone.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The
Storms Mfg. Co.

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Culvert Pipe, Vitrified.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co., The

Dump Wagons.
Austin-Western Road Machinery Co., The

Dust Laying Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Elastite.
Philip Carey Co., The.

Electrical Wires & Cables.
American Steel & Wire Company

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The.

Expansion Joint Compound.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
Sinclair Refining Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Crane Co.
U. S. Cast Iron Pipe & Fdy. Co.

Grab Buckets.
Mead-Morrison Mfg. Co.

Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Gravel Screener and Loader.
The Jordan & Steele Mfg. Co., Inc.
Good Roads Machinery Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists—Motor Truck.
Columbian Steel Tank Co.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
Flower Valve Mfg. Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Iron Fence.
Cincinnati Iron Fence Co.

Joint Fillers (Paving).
The Barrett Co.
Philip Carey Co., The.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.

paving with asphalt Ave. H, from E. 7th to Coney Island ave. Preliminary authorization granted on following: Recurbing, flagging where necessary, and paving with asphalt, widened portion of roadway of Lafayette ave., Flatbush ave. to Fulton st., estimated cost, $17,000; paving with asphalt E. 10th st., Ave. L to Ave. M, $15,000; asphalt paving 56th st., 14th ave. to 15th ave., $13,400; regulating and grading Ave. H, E. 7th st. to Coney Island ave., $8,400; regulating and grading where necessary E. 9th st., Foster ave. to Ave. H, estimated cost, $4,700; asphalt paving on E. 9th st., Foster ave. to Ave. H, $13,000.

N. C., Winston-Salem—Forsyth Co. contemplates rebldg. and resurfacing with Tarvia 6 miles Louisville rd., 16 ft. wide, macad., about $100,000. Work will probably be done by day labor.

N. C., Winston-Salem—Forsyth Co. plans to construct 6 miles Styers-Ferry rd., about $30,000.

N. C., Rutherfordton—Rutherford Co. plans to construct 4 miles Rutherford-Forest City rd; concrete, about $150,000. W. S. Fallis, care state hwy. comn., Raleigh.

O., Dayton—Estimates for paving Germantown road, from west corp. line northeast 4,968 ft., filed with city comn. Paving with asphalt will represent outlay of $129,971; with brick, $133,959; three alley paving estimates also filed, alley north of Oxford, Deal ave. east, $2,608; west of Waulkner, $4,643; east of St. Nicholas, $5,706.

O., Hamilton—Ordinance passed by council levying special assessments to amount of $65,590 for improvements on Lindenwald sts. The streets are Benninghofen ave., Belle to Hooven; Belle, Pleasant ave., to Dixie hwy, and Laurel ave., Pleasant to Benninghofen. Petition also filed for paving Caldwell st., 5th to 7th sts.

O., Lorain—State hwy. dept. announces that contract for paving and constructing blvd. betw. western city limits of Lorain and Oak Point bridge, 3 miles, will be let in August.

O., Steubenville—Estimated cost of repairing 7th st., South st. to Buckeye st., presented to council. Work involved 18,500 yds. paving, brick paving and cement cushion, cement filler, monolithic type, $166,477; wood block paving, $161,759. Estimates also presented for sidewalks on 7th st., total of 28,489 sq. ft. is involved and cost is $8,546.

Ore., South Bend—Carrying out of Pacific Co.'s big road program calls for expenditure of $162,000, insofar as South Bend comes in as a direct beneficiary.

Minn., Duluth—City commrs. purchased cast iron pipes for water and light dept. from American Cast Iron Co., at $47,221.

Pa., Beaver Falls—Paving program covering about 16 city blocks at least, with intersects, and entailing estimated expenditure of $102,000 has been presented to council and passed on favorably. Ordinances will be prepared.

Pa., Ebensburg—Bd. Supvrs. Adams Twp. have requested Cambria Co. to build 1⅛-mi. of brick road, from Geistoen to South Park, and 3 mi. brick road from Dunlo to Salix, county to pay two-thirds of cost and township one-third; Bd. of Supvrs. Croyle Twp. have asked approval for bldg. 1 mi. brick or conc. rd., from Lovett to Schoolhouse, 6½ mi. from Lamb's bridge to Brownstown rd, toward Wilmore, and 2 miles from Summerhill to W. Penny hwy. Total cost, $500,000. H. F. Door, Trust bldg., engr.

Pa., Scranton—Ordinance passed to grade, pave and curb Saunders st., Pittston and Birney aves.; sheet asphalt and stone block on conc. base, about $106,226. W. P. Huester, clerk.

R. I., Scituate (N. Scituate P. O.)—Water Sup. Bd., Providence, plans to construct 1.75 miles earth hwy. here, about $75,000.

S. C., Abbeville—Commrs. Abbeville Co. plan to construct 10 miles Abbeville-Due West rd., probably gravel, about $60,000. C. H. Moorefield, Columbia, engr.

S. C., Barnwell—Commrs. Barnwell Co. plan to build 10 miles Barnwell-Williston rd., probably gravel, about $50,000. C. H. Moorefield, engr., Columbia.

S. C., Canden—Kershaw Co. commrs., M. C. West, chrmn., will gravel and sand-clay roads; $400,000 available. L. Kirkland, engr.

S. C., Columbia—Richland Co. considering hard surfacing Two Notch rd., about $450,000. J. R. Pennell, engr., Richland Co.

S. C., Florence—City contemplates street paving which will cost about $800,000. Will engage consulting engineer. For details address mayor.

S. C., Monck's Corner—Commrs. Berkeley Co. plan to hard surface 5 mi. Murray's Ferry Rd., about $175,000. C. H. Moorefield, Columbia, engr.

Tex., Dallas—Property owners of Highland park plan to pave all sts., about $500,000. H. R. Davis, Highland park, mayor.

Tenn., Lexington—$350,000 bonds voted by Henderson Co. for road construction.

Tex., Midland—Midland Co. voted $125,000 bonds to construct highway. Total cost $242,000; state hwy. dept. recently granted $117,000 F. A. funds to help finance proj. J. W. DeArmond, Co. judge.

Tex., Texarkana—Council on Texas side has passed ordinance authorizing $600,000 bond issue for street paving purposes.

Utah, Lehi—City plans to curb, gutter and grade Main st., 60 ft. wide, 7-in. plain conc., about $35,000. Huddleston & Fiero, Kearns bldg., Salt Lake City, engrs.

Utah, Provo—City plans to pave .76-mi. 5th and West sts. to Denver & Rio Grande R. R. crossing, 20 ft. wide, 7-in plain conc., about $32,500. C. A. Swan, city engr.

Va., Portsmouth—Work on improvement of several streets in city will start soon. Council having appropriated $42,000 for the work.

Wash., Spokane—Issuance of bonds to amount of $95,000 for paving 7½-mi. of the Apple Way, east from Idaho state line toward Coeur d'Alene, has been authorized in Pleasant View dist., Kootenai Co.

Wash., Seattle—$300,000 road bonds have been sold which will enable Kitsap Co. to go ahead with construction of new "Beach Road," from Harper to Port Orchard.

Wash, Winlock—Ordinance providing for paving Kerron st. passed to final reading; improvement calls for 18-ft. paved street to city limits, estimated cost, $30,130.

W. Va., Madison—$142,000 bonds voted by Scott district, Moone Co., and will soon receive bids for grading 12 miles of road. J. P. Blundon, county engr.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Fresno—City trustees are considering proposition to construct laterals for N. Fresno sewer system by force action. If this is done city will probably lease ditching machine and employ supt. to have charge of the work. Resolution adopted by trustees to construct main and lateral sewers in new city sewer district.

Cal., Pasadena—City Engr. E. P. Dewey has prepared plans for sewers to serve the northwest section of city. For sewers in excess of 8-in. diam., city will have to provide about $5,300 and main cost $36,252 would fall to Flintridge and N. Altadena. In addition a sewer along east bank of Arroyo, betw. Brookside park LaLoma, estimated to cost $22,650 will be required.

Cal., Porterville—City Engr. Fred Pease has submitted to council a report on proposed new sewer system. Estimated cost, $35,000. Report taken under advisement.

Cal., Watts—Koebig & Koebig, consulting engrs., Title Ins. bldg., Los Angeles, have been retained by trustees to prepare plans and specifications for sewer system for city.

Colo., Denver—Final approval of Park hill storm sewer improvement proj. acted upon by city council. Ordinance approved creating east side storm sewer district No. 1, involving expenditure of approximately $173,000.

Idaho, Jerome—City having plans prepared by L. S. Kelsey, consulting engr., Nampa, for sewerage system here, about $150,000.

Ill., Fairbury—State dept. of health has approved plans for storm sewerage system here. Plans for san. sewerage system heretofore approved. Both systems will probably be installed during present season.

Ind., Dayton—Movement started here to build complete drainage system. It is estimated that adequate sewerage could be installed for approximately $40,000.

Ind., Mt. Vernon—Council considering building of new sewer system in extreme western section of city to take care of new school building to be built this summer, and new factory. Plans call for complete san. and surface sewer. Estimated cost betw. $12,000 and $15,000.

Ia., Bellevue—M. V. Norris, Webster City, making survey of city for proposed new sewerage system. Mr. Norris is vice-president of Currie Engr. Co., Webster City.

Ia., Dubuque—City Mgr. Carr has requested city engr. for an estimate on cost of constructing sanitary sewer in Liebnitz street, which was petitioned for by residents about a year ago.

Ia., Nevada—Engr. J. G. Dean, making survey for storm sewers and drainage. R. A. Davis, city clerk.

Mass., Northbridge—Bd. sewer commrs. plan to construct sewerage system and pumping station, about $142,000. C. W. Lasell, chrmn. McClintook & Woodfall, 15 Court Sq., Boston, engrs.

Mich., Muskegon—Council has decided to reject all bids for construction of storm and san. sewers in Heights and to make arrangements to do the work thru salaried man, who will be hired to superintend the work. All materials will be bought thru city purchasing agent. Supt. will be instructed to proceed with the work as far as the money ($320,000) will go.

Mich., Royal Oak—Twp. badly in need of sewer system and it has been decided to ask assistance of state bd. of health to remedy situation.

N. Y., Brooklyn—Bd. of est. has authorized preliminary work on sewer construction in Jamaica and Newton local board districts, Queens. Estimated to cost $297,000.

N. Y., N. Tonawanda—Bd. pub. wks. has commissined Chester & Fleming, cons. engrs., Union Bank bldg., Pittsburg, Pa., to submit report for sewerage system and sewage disposal plant.

O., Lima—Preliminary plans being prepared by Fulier & McClintock, engrs, 170 Broadway, New York City, for building sewage disposal plant, etc., about $1,000,000.

Tex., Dallas—Reconstruction of sanitary sewer connecting system of N. Dallas and sewage disposal plant, to eliminate trouble being experienced by overflow of Trinity bottoms, ordered by Mayor Wozencraft and work will start as soon as river bottoms are dry. Iron construction will replace clay pipe now used.

Va., Alexandria—Resolution appropriating $2,400 to construct sewer on N. Payne st., Queen to Oronoco sts., passed; also resolution appropriating $2,000 for sewer on West st., Cameron to Oronoco st., and in alley bounded by West, Payne, Queen and Princess sts.

Va., Norfolk—Recommendation from City Mgr. Ashburner that council appropriate $6,527.50 for sewerage in various streets was placed on first reading. Council voted $1,760 for sewerage in 40th st.

W. Va., Wheeling—City plans to install complete sewerage systems in Pleasanton, Crator and Park View, about $100,000. H. G. Conrad, city engr.

Wis., Kilbourh—W. G. Kichoffer, engr., 31 Vroman blk., Madison, preparing plans for 3,000 ft. 2½x7 ft. rock tunneling in connection with sewerage system.

WATER SUPPLY AND PURIFICATION.

B. C., Vancouver—To provide better fire protection for industrial section of city south of False creek City Engr. Fellowes has submitted plan of water works extension of mains and hydrants to civic water works comm. Proj. includes laying approximately 6,894 ft. 12, 8 and 6-in main.

N. B., St. Andrew—Plans being prepared and bids will soon be received for building water works system. $75,000 bonds voted for project.

N. S., Halifax—City council has decided to erect pumping station and to adopt a water meter plant involving the expenditure of approximately $70,000.

Can., Ont., Chatham—The E. A. James Co., Ltd., Toronto, engaged by the water comm. to supervise installation of new filters at local water works plant.

Can., Ont., London—Cities of London and St. Thomas contemplate building 25 miles of pipe line from Lake Erie, about $3,000,000. E. V. Buchanan, care Utilities Comn., engr.

Can., Ont., London—Mayor and council authorized Ont. Ry. & Mun. Bd., to grant an issue of $160,000 debentures to provide money for extensions absolutely necessary in water works and electric departments.

Can., Ont., Niagara Falls—Council will raise $33,000 for extensions and improvements to city hydro system.

Can., Ont., Oshawa—By-law submitted for authorization of construction of extension to water works system, costing $50,000. Thos. Morris, clerk, Oshawa.

Can., Ont., Scarboro—Township plans to construct branch water main and house services in connection with new water

BUYERS' GUIDE

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L. The.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Warren Bros. C o.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Smith Co., T. L., The.

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
Kentucky Rock Asphalt Co.
Sinclair Refining Company.
The Texas Co.

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Sinclair Refining Company.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Mayer, F.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co.

Road Oils and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Rock and Sand Heaters.
East Iron & Machine Co., The

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros.

Sand Dryers.
Cummer & Son Co., The F. D.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co.
W. E.
Clay Products Association.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
Crane Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co.

Stone Curbing.
Cleveland Stone Co.

Stone Elevators.
Austin-Western Road Machinery Co.

Stone Flagging.
Cleveland Stone Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
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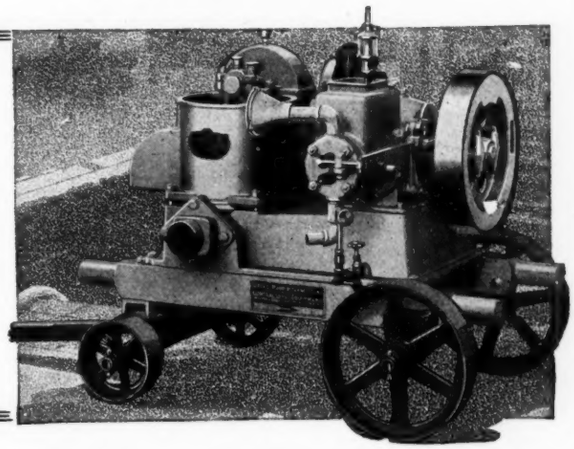

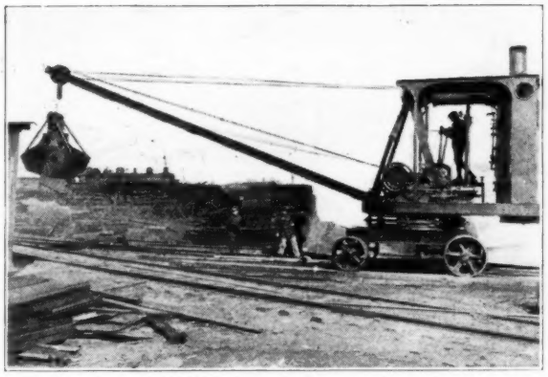

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works system, involving ½ and ¾-in. w. i. pipe, stop cocks, valve boxes, etc. Estimated cost about $200,000. E. A. James Co., Ltd., 36 Toronto st., Toronto, engrs.

Can., Ont., Sudbury—By-law will be submitted authorizing expenditure of $27,000 on construction of trunk water main. W. J. Ross, city clerk. Water wks. dept. will carry out work by day labor.

Can., Ont., Wingham—$25,000 bonds voted to extend water works system.

Can., Quebec, Buckingham—Town has set aside $75,000 for construction of alterations to water works system. Sec-Treas. David Ray.

Colo., Denver—$180,000 bonds voted for improvement of Denver's water system pollution.

Colo., Rocky Ford—Chamber of commerce advises enlargement of water works system.

Del., Georgetown—Chester H. Wells, state health officer, recommends erection of chloride plant for city.

Ind., Ft. Wayne—National Fire Underwriters recommend that immediate steps be taken to increase quantity of water available for present needs, by installing temporary filter plant with wooden sedimentation tanks and tub filters having aggregate capacity of at least 2,000,000 gals. per day.

Ind., Huntington—According to plan being made the town of Ubee (commonly known as College Park) will have own water works system. College Pk. Bldg. & Loan Assn. will establish the water works near corp. line of Huntington and furnish water for domestic use and fire protection to the town. Guy R. Bangs, Sec.-Treas.

Ind., Newcastle—Supt. Younce has been given authority to draw up specifications and advertise for bids for sinking of new 12-in. well, as water supply is running short. This will probably be only the first of a number of new wells to be sunk.

Kans., Mineola—Citizens have voted in favor of $45,000 bond issue for construction of water works system.

Kans, Peru—Plans being prepared by Archer & Stevens, engrs., 609 New Engineering bldg., Kansas City, for building water works system. Estimated cost about $50,000.

Kans., Portis—City having plans prepared by Archer & Stevens, engrs., Kansas City, for constructing new well, water works and distributing system, about $32,000.

Md., Cumberland—City contemplates installing water connections for 61 houses in Ridgedale section. Mr. Rizer, city engr.

Mass., Boston—Commr. of public works states it is his intention to construct surface water conduit of conc., 9 ft. by 8 ins. by 10 ft. for purpose of carrying Muddy river with necessary surface drain connections, and 4 catch basins in Brookline ave., betw. Beacon st. and Audubon rd., in Roxbury district. Estimated cost, $301,000.

Mass., Haverhill—Water board has voted to install meters in all houses containing more than 4 apartments.

Mich, Adrian—Purchase of Adrian water plant for $220,000 and a $65,000 additional bond issue to care for extensions and improvements to water system during coming year, ratified at special election recently.

Mich., Grand Rapids—Survey for addition to city filter plant has been started. R. E. Harrison, Toledo, cons. engr., has been retained to superintend the work. All drafting of specifications, preparation of plans, etc., will be done at the filtration plant.

Mich., St. Clair—Plans being prepared for furnishing and installing 300 h. p. engine, 200 kva. direct-connected generator, water meter, piping, etc.; also 6 and 10 in. water mains, in Orchard and 9th sts., town line, Riverside and Clinton aves., about $57,755. G. C. Champe, Toledo, O., engr.

Minn., St. Paul—Plans for improvements of city water works will be considered by water board in near future. Mr. J. W. Kelsey, supt. water wks., recommends bond issue of $2,000,000 for improvements, including an 8-mi. conduit to tap Miss. river supply.

Mont., Browning—$60,000 bonds voted for water system here.

N. J., Hackensack—Hackensack Water Co. will make water connections in 3 Woodcliff streets now under improvement.

N. H., Portsmouth—Council has appropriated $45,000, ordered by bd. of pub. wks. to establish gravel screen wells in place of present water system.

N. Y., Mantins—Village considering installation of new water system, approximate cost, $20,000. H. J. Crane, atty., interested.

N. D., Hankinson—Dakota Engr. & Construction Co., Valley City, N. D., are preparing plans for water works and sewer system for Hankinson. Bids will be asked shortly.

O., Alliance—$40,000 steel and concrete dam at water works will have to be extended and perhaps rebuilt. Bonds will be issued and work on repair of new dam will be started immediately.

O., S. Euclid—Election on $140,000 bond issue for water system reported favorable.

Ore., LaGrande—Plans being prepared by L. C. Kelsey, cons. engr., Portland, for gravity water supply system, cost betw. $500,000 and $1,000,000, depending upon source of supply recommended.

S. C., Springfield—Town will install water and sewer systems. Estimates prepared. Engrs., Ryan Engr. Co., Columbia, S. C.

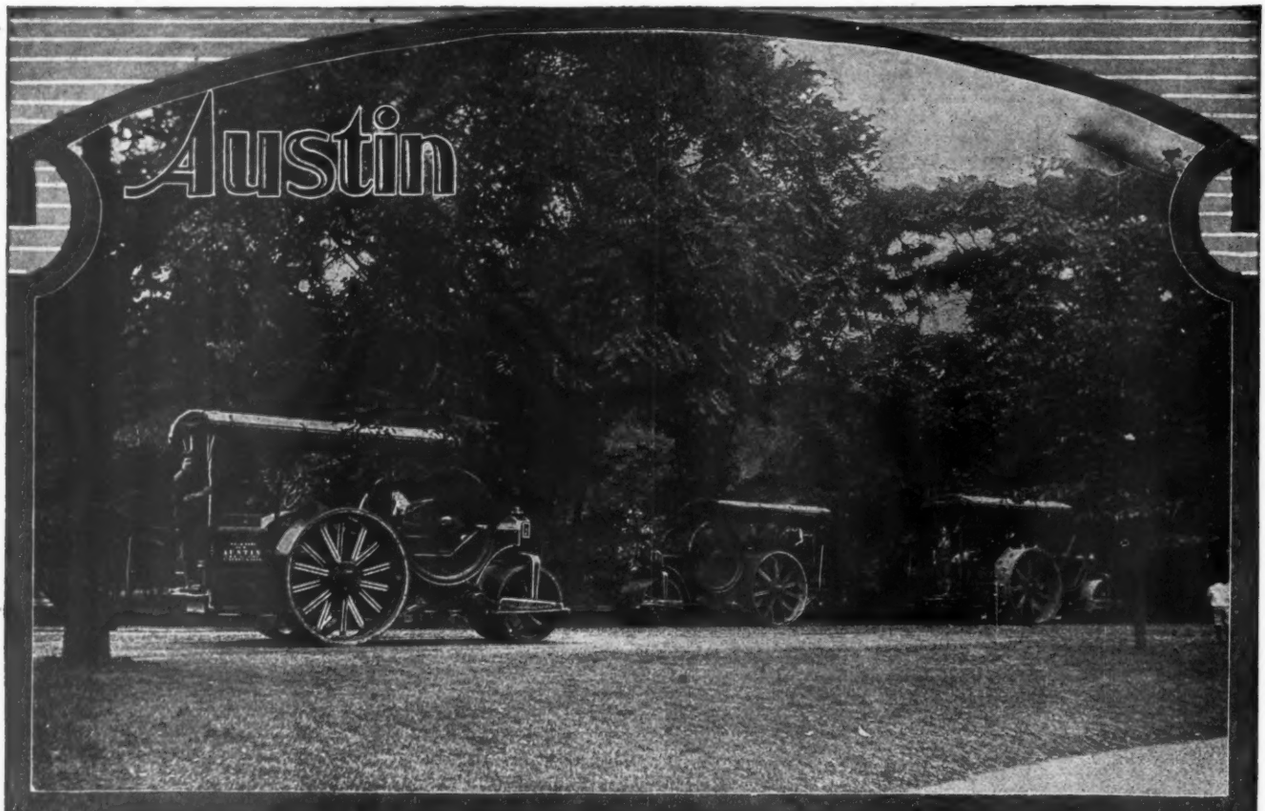
S. C., Union—$70,000 bonds voted for improvement and extension of water works. R. P. Morgan, mayor.

Tenn., Nashville—City comn. has adopted resolutions asking Davidson Co. legislative delegation to request Gov. Roberts to authorize city to issue water works improvement bonds and short term notes. It is desired to issue $225,000 water works bonds.

Utah, Salt Lake City—Appropriation of $25,000 made for installing 8-in. pipe line from Capitol hill down 6th st.

Va., Charlottesville—City plans to extend water works system at cost of about $200,000. Includes pipe line and new pumping machinery.

Wash, Centralia—New reservoir will be constructed on Seminary hill by city and will be paid for with emergency warrants issued against city's current expense fund. Mayor Rogers has obtained approval of state bureau of inspection of plan and new 1,000,000-gal. reservoir will be started shortly. Estimated cost, $20,000. This reservoir will be used solely for fire protection.



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